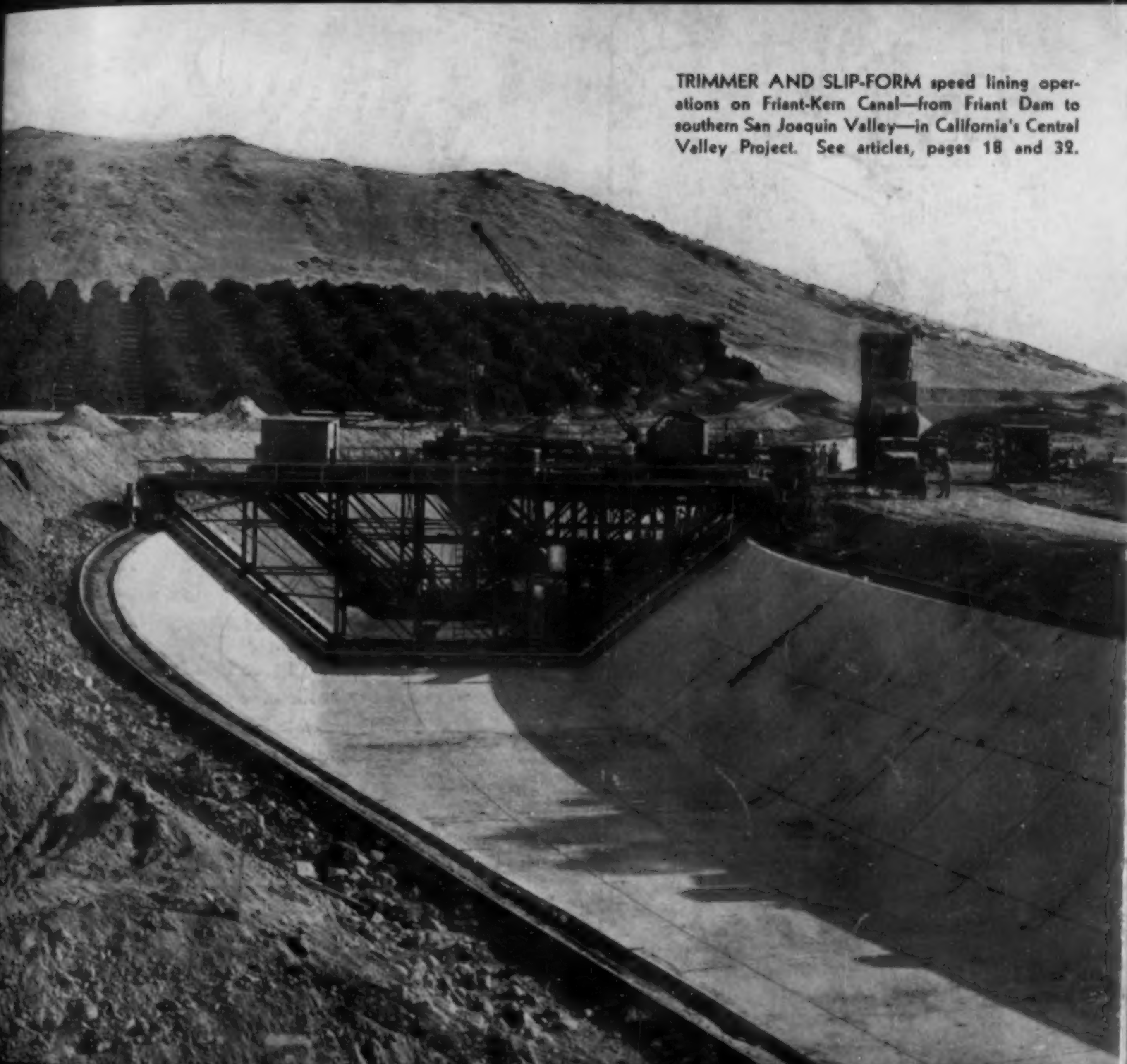
CIVIL ENGINEERING



TRIMMER AND SLIP-FORM speed lining operations on Friant-Kern Canal—from Friant Dam to southern San Joaquin Valley—in California's Central Valley Project. See articles, pages 18 and 32.

Water Plan of California Anticipates State-Wide Development—Hyatt and Morris

Century of Progress Marks Many Improvements in Locks and Dams—Jansen

Mechanical Trimmer and Slip-Form Expedite Canal Lining Operations—Heitman

East Meets West in Controlling China's Yellow River—Todd

NEW YORK International Airport at Idlewild, Queens, is major item in New York Port Authority's expansion program. Site on former marsh and meadow lands is sand fill dredged from Jamaica Bay in largest hydraulic-fill operation of its kind ever undertaken. Six completed concrete runways, 12 in. thick, vary in length from 6,000 to 9,500 ft and are 200 ft wide. Seventh runway is scheduled for completion January 1. Completed airport will be nine times as large as LaGuardia. Fairchild Aerial Surveys, Inc., N.Y.

New York Port Authority Administers $200,000,000 Airport Program

DURING ITS FIRST 14 months of operation, the New York Port Authority, charged with postwar expansion of airport and seaport facilities in the New York metropolitan area, has let contracts totaling approximately $10,000,000 and bids have been requested on an additional $5,500,000 of airport construction. As part of a $200,000,000 program the New York International Airport, to be the largest and most modern in the world, was opened for limited service July 1 of this year (CIVIL ENGINEERING, August 1948, page 68).

In addition to the completion of temporary terminal facilities, the opening of the airport and the leasing of all its available facilities, the Port Authority in the first 14 months of its program at New York International:

1. Proceeded with the construction of the new Runway V, the seventh runway at the airport, scheduled for completion about January 1, 1949.
2. Completed plans for construction of two additional 300-ft-span hangers, recently advertised for bids.
3. Carried forward the construction of gasoline storage and handling facilities, which will be completed in the middle of October with a capacity of 600,000 gal, almost equal to all the gasoline storage capacity now available at LaGuardia Airport.
4. Extended the length of Runway D from 6,000 to 9,500 ft and carried forward the construction of taxiways for Runways D, E, and F, to be completed by October.
5. Let contracts for the extension of the Thurston Basin sewer, a necessary step in the development of the entire easterly area of the airport.
6. Negotiated an agreement with the federal government for the erection of a $4,500,000 building, which is now under construction and which will be completed early in 1949 for the housing of 400 to 500 employees of the Civil Aeronautics Administration and the Weather Bureau.

MILLION-DOLLAR UNDERPASS (above) provides for four lanes of vehicular traffic to future 500-acre central terminal area. Taxiway bridges, above, are capable of carrying heaviest modern planes. Saucer-like construction of underpass, 5 ft below water level, is kept drained by single automatically controlled pump.

TWO 300-FT-SPAN HANGARS with ample apron space either side are completed and many other buildings are under construction.

NORTH AND SOUTH BRIDGES of Van Wyck approach road in westerly section of airport (below) will provide access to Federal Building and future airlines facilities. Building for housing 400 to 500 CAA employees is being constructed at cost of $4,500,000.

Water Plan of California Anticipates State-Wide Development of Water Resources

EDWARD HYATT, M. ASCE
State Engineer, Sacramento, Calif.

INCREASED POPULATION and the resultant accelerated uses of water for many purposes in California emphasize the need for preparing state-wide advanced plans for projects such as those developed for the Central Valley and the Santa Ana River. Although a State Water Plan was authorized by legislative enactment in 1921 the report was not completed until 1931 after which date the planning work was practically suspended. Lack of plans has therefore delayed projects urgently needed throughout the state and has brought action by the State Water Resources Board through the Division of Water Resources in revising and extending the old State Water Plan. A program inaugurated by the state legislature in 1947 and laid out on a three-year basis has as its objective the preparation of a comprehensive plan which will meet the water needs in all areas of the state. Details of the program and the need for negotiation, arbitration, or litigation to determine water rights of states bordering the Lower Basin of the Colorado are outlined here by Edward Hyatt, M. ASCE, California State Engineer. Supplementary remarks by Samuel B. Morris, M. ASCE, are included in the discussion which follows. Mr. Hyatt's paper and the discussion by Mr. Morris were presented before the first All-California ASCE Convention at Fresno, Calif. A report of the Fresno Conference, with full details on all sessions and activities, appears in the June issue of CIVIL ENGINEERING, page 57.

THE SUBJECT, Water Plan of California, can be approached in several different ways. The simplest would be to give a chronological description of the physical works built through the years. A better way would be to trace the historical growth of the use of and need for water, and the droughts and shortages that have occurred, since it is these which spur the making of regional or state-wide plans.

What really brings about the creation of a water plan is a recognition of the need for it, at the state level, and the resulting legislation directing and financing its preparation. Such a plan usually is not started until the need is apparent, and an expensive delay follows while the plan is being produced.

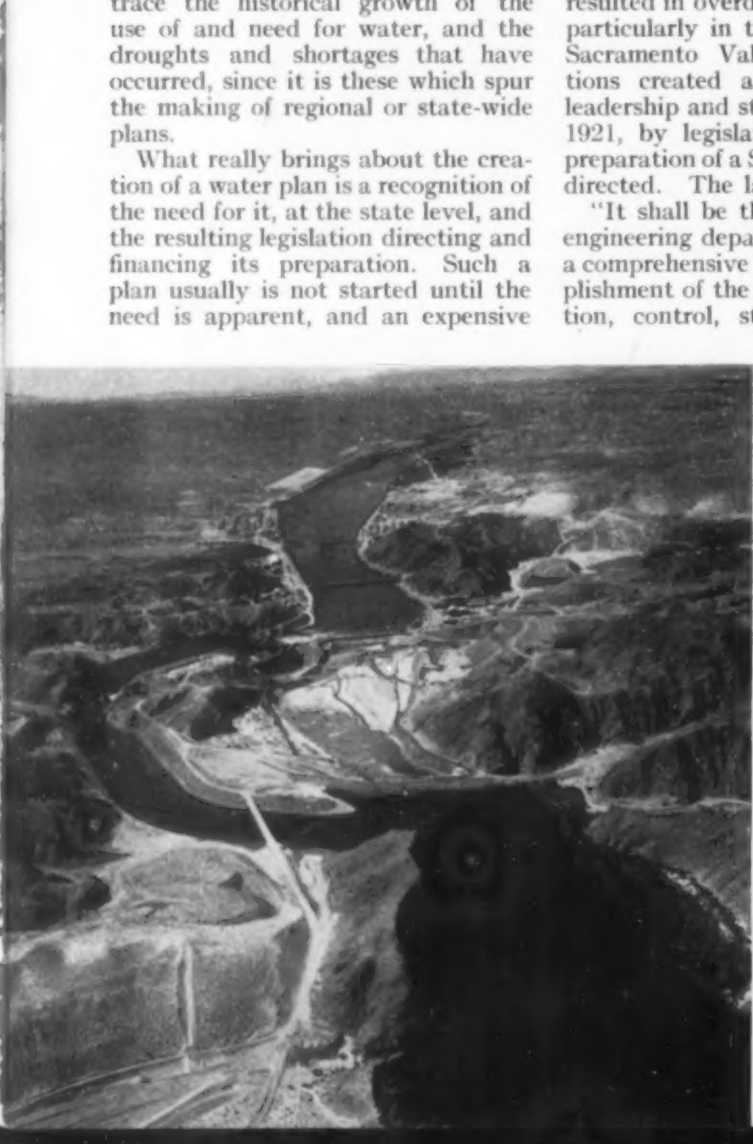
The rapid development of California in the decade following 1910 greatly increased the area under irrigation. The greater use of water resulted in overdrafts in many places particularly in the San Joaquin and Sacramento Valleys. These conditions created a demand for state leadership and state planning, and in 1921, by legislative enactment, the preparation of a State Water Plan was directed. The law stated in part:

"It shall be the duty of the state engineering department to determine a comprehensive plan for the accomplishment of the maximum conservation, control, storage, distribution, and application of all the waters of the state."

The legislative act also appropriated \$200,000 for the work. But instead of two years and \$200,000, ten years and over a million dollars were required for the development of the so-called State Water Plan. The results were presented in Bulletin 25 of the Division of Water Resources, entitled "Report to the Legislature of 1931 on State Water Plan." In this report and a series of supplements, the physical facts relating to water in California were given.

For study purposes the state was divided into the following basins: North Pacific, Sacramento, San Francisco Bay, San Joaquin, Central Pacific, South Pacific, and Great Basin. For every stream or area in the state, data on the following subjects were reported: The average, maximum, and minimum water supply; flood data; the quantities of water now being used for all purposes, both in amounts and locations; water duties in different parts of the state; careful estimates of future water needs; and ultimate requirements for all kinds of uses.

The engineering investigations clearly brought out the principal problems in the preparation of a plan for the use of surface waters. Regulation would be necessary so that winter flood waters could be held over until summer or until another season, and the water so regulated must be taken from the place of storage to the place of use. Flood control, a necessary prerequisite, could be obtained at the storage reservoirs, which would be useful for this purpose as well as for conservation.



DIVERSION CHANNEL carries Colorado River around Davis Dam site. Aerial view looking downstream shows powerplant intake and spillway structures at far end of channel. Area in old river bed between upper and lower cofferdams has been pumped out and soon will be excavated. (See CIVIL ENGINEERING, August 1948, page 24.) Next operation is placing of earth- and rock-fill embankment. Project located 67 miles below Hoover Dam has been under construction since early 1946 and is scheduled for completion in two years.

SHASTA DAM (above)—power, irrigation and flood control structure on Sacramento River—is part of Central Valley Project adopted and financed by United States at estimated cost of $411,000,000. Mt. Shasta is seen in background.

PARKER DAM (above), built by Bureau of Reclamation under contract with Metropolitan Water District of Southern California, forms lake from which water is pumped and started on its way to Los Angeles metropolitan area, 267 miles away.

FRIANT-KERN CANAL (above) in Central Valley Project will carry water from Friant Dam on San Joaquin River to southern part of San Joaquin Valley. View shows trimming and lining operations in deep cut 6 miles below dam.

AIR VIEW OF IMPERIAL DAM (above) shows desilting works designed to remove some 50,000 tons of silt per day from Colorado River water entering All-American Canal (foreground). Basins and channels between headworks and beginning of main channel of canal cover 92 acres. Each basin is approximately 269 × 769 ft.

WESTLEY WASTEWAY (left) when completed will extend from Delta-Mendota Canal to San Joaquin River. In foreground is California State Highway 33 which runs from Tracy to Mendota.

SAN DIEGO AQUEDUCT connecting Colorado River Aqueduct to San Diego is now in operation. In construction view, Lima Type 1201 air-control crane, equipped with 60-ft boom, lays $17^1/_2$-ton sections of 72-in.-dia concrete pipe. (See article in July 1947 issue of CIVIL ENGINEERING.)

In the basins of the Sacramento and San Joaquin Rivers, called the Central Valley, and in some parts of Southern California, preliminary construction plans were developed, based on the engineering facts obtained. An initial plan for immediate construction in the Central Valley was laid out. Later named the Central Valley Project, this development has been under construction by the U.S. Bureau of Reclamation for twelve years, and is proceeding steadily toward completion.

Following the submission of Bulletin 25 to the Legislature of 1931, further work on the state plan was practically suspended. It is to be noted that actual project plans were available only for the Central Valley and the Santa Ana River. The result is that the Central Valley has been in a position to reap the most benefit. With plans well advanced, the Central Valley Project was adopted and financed by the United States for construction at an estimated cost of \$411,000,000, of which about \$229,000,000 was spent by June 30, 1948. Other parts of the state needing and meriting water projects have been held back by lack of such plans.

Recently this lack of preparation has been brought strongly to the fore, particularly by the State Water Resources Board, which has the duty of planning water development. The State Engineer is engineer and secretary of the Water Resources Board, and the Board's engineering work is performed by the Division of Water Resources. The State Water Resources Board has considered and recommended the revision and extension of the old State Water Plan. The legislature, by Chapter 1541, Statutes of 1947, directed that such work be undertaken, and appropriated \$140,000 to start it. The study has been laid out on the basis of a three-year job costing \$500,000 and is well started.

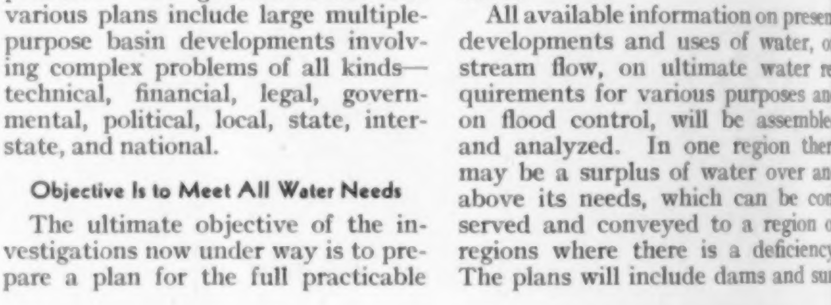
The program of development of the State Water Plan, by virtue of its scope and magnitude, is of necessity continually subject to alteration and modification. The increasing uses and needs for water, the developing shortages, the delays caused by the war, and the rapidly growing population of the state have created water problems and stimulated the development of various features of the plan by public and private agencies. Innumerable plans involve all the known uses of water—navigation, irrigation, municipal, industrial, hydroelectric power, mining, recreation, and the preservation of fish and wild life, as well as the control of water, problems of floods, soil erosion, salinity, and pollution of groundwaters. The various plans include large multiple-purpose basin developments involving complex problems of all kinds—technical, financial, legal, governmental, political, local, state, interstate, and national.

Objective Is to Meet All Water Needs

The ultimate objective of the investigations now under way is to prepare a plan for the full practicable conservation, control, protection, and utilization of the state's water resources, both surface and underground, to meet the water needs for all beneficial purposes and uses in all areas of the state in so far as practicable.

The state has been divided into seven regional areas for study. The investigation for each region will of necessity include general topographic and physiographic features, sources and amounts of the available water supply, and present development. Analyses of the water supplies will cover precipitation, temperature, stream flow, snow storage, underground storage, and quality of water. Data on flood flows will be collected and analyzed. Studies of water requirements involve analyses of soil and topographic conditions and their adaptability to the growing of crops with and without irrigation. They also involve the preparation of estimates with respect to the rate of growth of population, of irrigated land and of industry, and the probable ultimate values for each of those items.

All available information on present developments and uses of water, on stream flow, on ultimate water requirements for various purposes and on flood control, will be assembled and analyzed. In one region there may be a surplus of water over and above its needs, which can be conserved and conveyed to a region or regions where there is a deficiency. The plans will include dams and sur-



PRADO DAM ACROSS SANTA ANA RIVER is Orange County Flood Control improvement. Construction view of dam shows diversion channel and outlet works. Tower at right houses gates for controlling flow of water through outlet structure.

ace reservoirs, canals and conduits, umping plants, and appurtenant orks, for the purposes of storing, iverting, conveying, and distributing ater to areas of use, and utilization f underground basins. Electric ower plants will be located at the torage reservoirs, and the stream systems will be developed for hydroelecric power where economically feasble.

Since the reports of 1930, which for he first time presented accurate and omplete facts and laid the foundaion for the construction of works for he control and use of water by both rivate and governmental agencies, here have been 20 years of additional ecords of rainfall, runoff, floods, etc., hus changing the basic data. Other ew factors have radically altered the ituation in California. Foremost mong these factors, of course, has een the great westward trek of opulation which began in the days of he Dust Bowl exodus, accelerated uring the war, and still continues oday. In 1920 California's population was less than 3,500,000. In 1940 it was 6,907,000 and today, eight years ater, it is about 10,000,000.

The rate of shift in population to he states of the Far West, heretofore ttributed to the war effort, has coninued after the war. California is herefore faced with changing and more intensive agricultural practices nvolving a greater demand for water, nd has an entirely new industrial conomy, with water demands far in xcess of those estimated ten years go.

In developing a water plan today, ome interesting and important problems must be considered which were

METROPOLITAN INTAKE PUMPING PLANT at Lake Havasu starts Colorado River water on its long journey to Los Angeles.

not present when the previous work was started in 1921, or were not given the emphasis that is necessary now. An excellent example is the new awareness of the importance of fish, wild life, and recreation, which call for the use of certain of our water resources. The use of water for fish is strongly advocated by a large number of people and this attitude has been reflected in the laws relating to fish in a manner not consistent with the laws relating to water. Request has been made for the release of stored water from reservoirs created for irrigation and power purposes, to maintain fish life. The makings of a first-class controversy are evident in the demands for water on behalf of fish and wild life particularly, and full factual information and careful study will be required to integrate such uses with the minimum of damage to all interests.

As a partial answer to this problem the Division of Water Resources has recommended an intensive investigation of the North Coast area from San Francisco to the Oregon line as a possible fishing, hunting, and recreation area. Here there is a surplus of water, excellent recreation possibilities, and very little agricultural land. Contrast this area with the San Joaquin Valley, which has great irrigable areas, very few perennial streams, and a definite shortage of water.

Interrelated Projects

Not a part of the state plan, but directly interrelated, are projects under construction, investigations in progress, federal policies, and many other items. A few will be mentioned.

Chapter 1514, Statutes of 1945, and succeeding statutes relating to the State Water Resources Board, provided that in the case of federally authorized flood control projects in California, the state would pay costs ordinarily assessed against local agencies and about $30,000,000 would be appropriated for this purpose, to be handled through the Board. This figure was arrived at by totaling the amounts of local cost required for the projects authorized by the Flood Control Act of 1944 (Public law 534, 78th Congress, 2d Session) and preceding acts. As these cost estimates were made several years ago they are now insufficient. According to the latest estimates, state costs on presently authorized projects will amount to some $50,000,000.

The Board has taken an active part in urging adequate Congressional appropriations to the Corps of Engineers for construction of these federally authorized flood control projects in California. It has contended vigorously that the size of the appropriations is not consistent with the authorizations and does not reflect the realities of the situation. Congress, following recommendations of the Chief of Engineers, has authorized the construction of flood control projects in this state which will cost from 500 to 600 million dollars. The present rate of appropriation of 15 to 20 million dollars a year will require more than 25 years for completion of those projects now authorized without regard to future authorizations, and this delay will result in damages from floods which the Board contends it was the intention of Congress to prevent.

CONCRETE SIPHON INTAKE on Friant-Kern Canal, designed for water velocity of over 13 ft per sec, is inspected by ASCE group during Fresno Conference of California Sections.

TEMPORARY WEIR ON COLORADO RIVER, constructed during war to divert water for irrigation of lands in Palo Verde Irrigation District in vicinity of Blythe, Calif., replaces badly silted old intake down river.

That this contention of the Board is sound and is receiving recognition by the Corps of Engineers, is shown by a table of estimated expenditures which was presented to the House Subcommittee on Appropriations by the Corps of Engineers during the hearings on the Civil Functions bill this year. The Corps' program calls for an expenditure in California of $53,500,000 in 1950; $62,000,000 in 1951; $55,000,000 in 1952; $39,000,000 in 1953; and $31,000,000 in 1954, leaving a balance of $193,000,000 required to complete presently authorized projects after 1954.

There are two authorized flood control projects in the San Francisco District of the Corps of Engineers; twelve in the Sacramento District; and eleven in the Los Angeles District, including one on the San Diego River and Mission Bay, which is partly for flood control and partly for river and harbor development.

Colorado River Situation

As to the Colorado River situation, over a million acres of land, about half of which is now irrigated, in the desert region of southeastern California, situated chiefly in the Palo Verde, Imperial, and Coachella Valleys, is dependent almost solely on the Colorado River as the source of water supply for irrigation and for domestic and industrial purposes as well. The municipal areas of Southern California, including those within the approximately 2,200 square miles of coastal plain and foothills extending from Los Angeles to Riverside and San Bernardino, and those in the vicinity of San Diego, embracing a present population of more than 4,000,000 inhabitants, are dependent upon the Colorado River as a source of supplemental water supply. The total amount of water in the Colorado River required and contemplated to be used in Southern California aggregates nearly 5,500,000 acre-ft annually. Works and facilities have been constructed or are in process of construction looking to the progressive utilization of this entire amount within a reasonable period of years. The main works are already built and in operation.

Construction of the All-American Canal was started in 1934 and in February 1942 the delivery of the Imperial Irrigation District's water supply was begun through the canal, and the use of the old Imperial Canal through Mexico was discontinued except for Mexican service. Construction of the Coachella Branch Canal, started in 1938, is nearing completion. In addition to the work undertaken by the federal government, construction of the Colorado River Aqueduct was undertaken and financed directly by the Metropolitan Water District of Southern California.

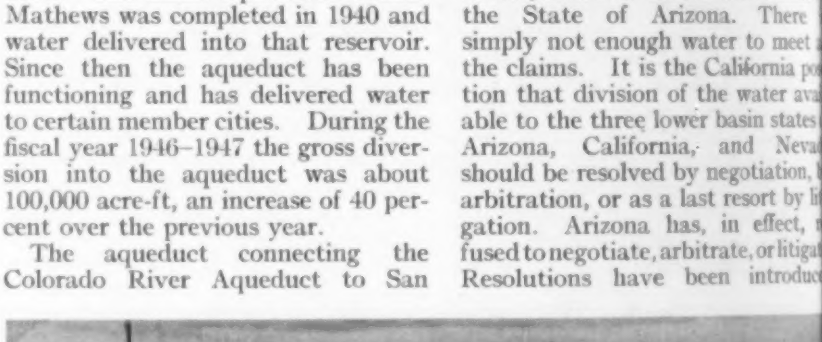
Construction on the aqueduct was started in 1933 and on Parker Dam in 1934. The main aqueduct to Lake Mathews was completed in 1940 and water delivered into that reservoir. Since then the aqueduct has been functioning and has delivered water to certain member cities. During the fiscal year 1946–1947 the gross diversion into the aqueduct was about 100,000 acre-ft, an increase of 40 percent over the previous year.

The aqueduct connecting the Colorado River Aqueduct to San Diego has recently been complet[ed] and placed in operation. The S[an] Diego County Water Authority, [in]cluding the City of San Diego, h[as] joined and is now a part of, the Metr[o]politan Water District of Souther[n] California.

Colorado River projects represe[nt] investments or firm commitments [by] Southern California agencies agg[re]gating nearly $550,000,000. T[he] water rights on which these inve[st]ments rest, some of which were ini[ti]ated prior to 1900, are set forth in [a] series of contracts which were ex[e]cuted from 1931 to 1934 betwe[en] California agencies and the Secr[e]tary of the Interior, and which call [for] for the delivery of a total of 5,362,0[00] acre-ft of water annually.

Not Enough Water to Meet All Claims

Since that time, a dry cycle of yea[rs] has reduced the mean annual flow [of] the river. The execution of t[he] Mexican treaty increased the amou[nt] of water delivered to that count[ry] substantially above previous es[ti]mates, and new claims were made b[y] the State of Arizona. There [is] simply not enough water to meet a[ll] the claims. It is the California po[si]tion that division of the water avai[l]able to the three lower basin states [of] Arizona, California, and Neva[da] should be resolved by negotiation, [by] arbitration, or as a last resort by li[ti]gation. Arizona has, in effect, r[e]fused to negotiate, arbitrate, or litigat[e]. Resolutions have been introduc[ed]



MADERA CANAL AND FRIANT DAM are seen in view looking upstream from highw[ay] bridge near town of Friant. Located on San Joaquin River in foothills of Sierras, Friant D[am] is important link in California's Central Valley Project.

Congress by California Congressmen to authorize a suit in the U.S. Supreme Court to determine the water rights in the Lower Basin of the Colorado River.

An item or two of general interest to those following water matters will be mentioned. First, there is the Flood Control Act of 1944 and, in particular, the so-called O'Mahoney-Milliken amendments thereto. For many years the western states generally were dissatisfied with the paramount legal right of navigation to water, superior to irrigation and other consumptive uses. The 1944 Flood Control Act and the 1945 Rivers and Harbors Act provided that the use of water for navigation in the West should not conflict with any beneficial consumptive use, present or future; also that, in the future, water reports of the Chief of Engineers and the Secretary of the Interior for this area should, before being sent to Congress, be submitted to the governor of each of the affected states, following which the state would be allowed 90 days to submit its written views and recommendations on such reports.

It will be seen at once that these laws created important new state duties and jurisdictions. Reports of the War and Interior Departments on the Central Valley Basin alone proposed expenditures running into between two and three billions of dollars. Bureau of Reclamation reports on the Colorado River Basin list projects with greater total cost figures and, although these projects are mainly in other states of the Colorado Basin, they are of vital importance to California. Since these laws became effective, many California state reviews of reports prepared by the Bureau of Reclamation and the Corps of Engineers have been submitted to these agencies by C. H. Purcell, M. ASCE, State Director of Public Works, who was designated by Governor Warren to act in this matter.

Water Plan Presentation Lacks Emphasis on Municipal and Industrial Development

SAMUEL B. MORRIS, M. ASCE

General Manager and Chief Engineer, Department of Water and Power, City of Los Angeles

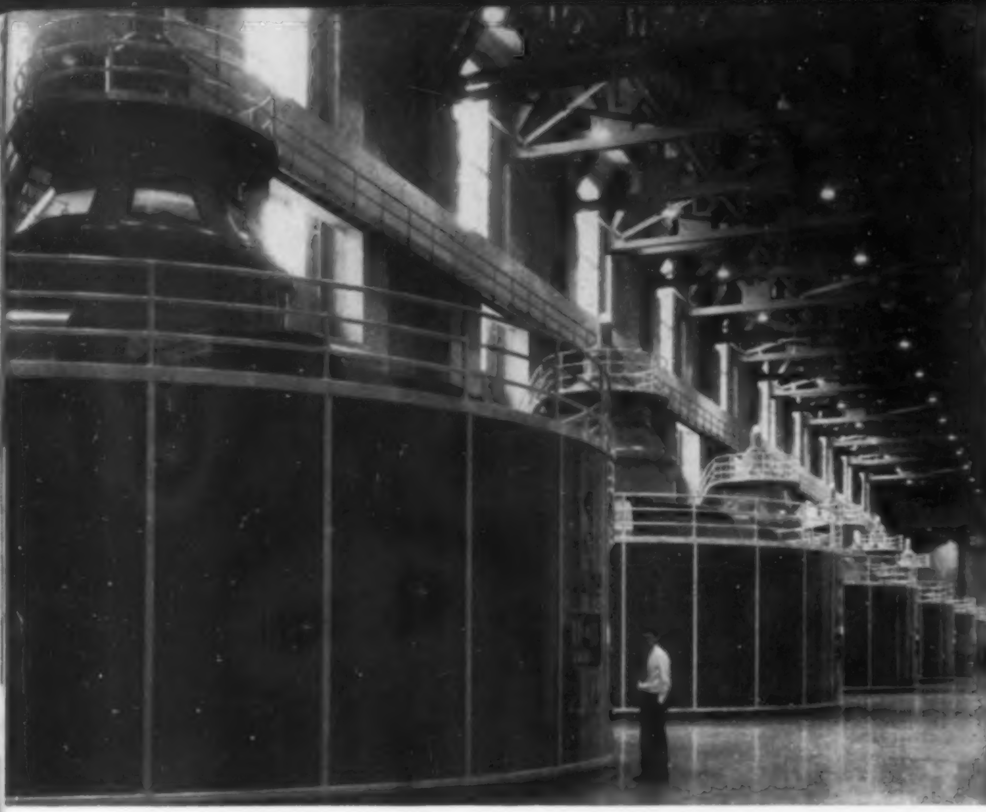
AS DEVELOPED and as presented, the Water Plan of California is largely a program for the irrigation development of the Sacramento-San Joaquin Valleys. Except for mention of the Metropolitan Water District of Southern California and of a recent addition to the District of the San Diego County Water Authority in connection with the Colorado River, there is little mention of the public water supplies of the cities of California which constitute some 75 percent of the state's population. While California continues to grow in agriculture, it is among the most, if not the most, urban of the states of the Union in that more than 60 per cent of its population is in the two metropolitan areas of Los Angeles and San Francisco. We should not forget that California's war production was second in the nation and that the prosperity of its 10,000,000 people, including those crowding its cities, can be met only by a balanced industrial development in which water, power, and fuel are the most fundamental necessities.

WATER PLAN OF CALIFORNIA stresses irrigation needs, but increased water supplies for urban growth and industrial development are equally important. Pictured here is Leevining Intake, almost directly east and in same latitude as San Francisco, where first water is intercepted by great Los Angeles Department of Water and Power Aqueduct which reaches city 337.8 miles south of point shown.

War clouds have been more prominent than rain clouds in much of the present year. What condition are we in to meet the pressure of increased production of manufactured goods? The answer throughout the Pacific Coast manufacturing centers and in general throughout the nation is a critical lack of power reserves.

World War II followed a period of depression and surplus capacity and surplus goods. Then, too, the U.S. Government had built important hydroelectric projects—Hoover, Bonneville, Grand Coulee, and TVA to name the major developments—with millions of kilowatts of capacity available for war production at a critical time.

Those of us who manage utilities, both publicly and privately owned,



WITH INCREASED WATER SUPPLY comes hydroelectric development, equally important factor in state's development and in strengthening national defense. View shows Nevada wing of Hoover Dam Power Plant. Installed generating capacity of plant is 1,031,250 kw, with provision for ultimate increase to 1,317,500 kw.

know the responsibility that is ours to anticipate the ever-growing demands for water and power in our communities. The Congress and other legislative groups do not seem to have an awareness of the public utility obligation to provide service in advance of needs. In the face of present critical shortages in power reserves, many are still thinking in terms of holding back water and power projects so as not to compete with labor and material demands, with utter disregard of consumer demands and national security.

Prior to World War II, the City of San Francisco, the East Bay Municipal District, the Marin Municipal Utility District, and the Metropolitan Water District of Southern California had all recently completed important domestic and municipal water supply projects with ample margin for the increased demands of war industries. To these developments were added years of favorable rainfall during the war, which enabled San Diego to squeeze by in its great war activities.

All will undoubtedly agree that this country must be prepared for war in order, if possible, to avert war and, if necessary, to wage war successfully. We are inferior in manpower. Our great superiority is in productive capacity. The foundation of productive capacity is adequate water, electric power, and fuel.

No discussion of water and power developments in California and the Southwest is complete without mention of fuel conditions. California gas supplies are already inadequate and gas is being imported from Texas. Oil production and consumption are just about in balance and it appears that the great additions to population and industry and the 1,750,000 kw in steam capacity under construction by the electric utilities in the state will force California into the position, for the first time, of becoming an oil-importing rather than an oil-exporting state, causing a rise in the price of fuel oil. Because of the oil outlook, we are providing for eventual use of coal in our steam plant designs.

There are undeveloped hydro power sites on the Colorado River from Glen Canyon downsteam with an energy potential equivalent to the burning of 25,000,000 bbl of oil per year in steam plants. The Bridge-Glen development alone should approach the equivalent of 15,000,000 bbl of oil per year. This economic loss continues each year that these sites remain undeveloped. The demand is here. Such hydro projects are sound and economically feasible. There must be an awakening of the people and of the Congress to the need for rushing these projects to completion on sound economic lines. Continued failure of the United States to rush construction of major hydroelectric projects on the Colorado River, the Columbia River, and other international and interstate streams where it has assumed sole responsibility for constructing such works, forces the utilities to construct less efficient hydro plants on smaller streams or high operating-cost steam plants.

Mr. Hyatt has commented on r leasing water in stream channels f sport fishing. Ah! Here is a field which every citizen and legislator keenly interested. It is well to weig the added fishing opportunity creat by dams and reservoirs and annu stocking from hatcheries whi largely offset changed stream fishin opportunities. Also, everyone shou weigh the costs. Ten cubic feet p second falling 1,000 ft in one ye actually generates 5,500,000 kwhr, the equivalent of 11,000 bbl of oil the present cost of $25,000 per yea or the interest on one million dolla at $2^1/_2$ percent—important contrib tions to the conservation of natur resources and to economy.

California's Interest in the Colorado

Half the population of California directly interested in the Colorad River and has expended or guarante repayment of $550,000,000 in work already constructed for irrigatio flood control, silt control, domesti water supply, and electric powe Security of water supply for 5,000,00 people and 1,000,000 acres of irrigate lands is being threatened.

Arizona has introduced bills befo Congress which would authorize th $738,000,000 Central Arizona Proj ect to construct the Bridge Canyo Dam, divert 1,200,000 acre-ft o water per annum at Lake Havas behind Parker Dam, and by a 1,000-f pump lift and a 242-mile cana convey it to some 226,000 acres of land in central Arizona which, it i claimed, would remain or revert t desert if this water is not secured The irrigation capital cost of $1,60 per acre is to be entirely repaid b the power users, primarily in Cali fornia. These lands when irrigate have a value of perhaps $300 per acr and cannot afford to pay more tha operating costs.

Unfortunately, the flow of th Colorado River is such that, wit existing allocations and priorities, i cannot furnish the water sought b central Arizona and at the same tim supply the Metropolitan Water Dis trict of Southern California wit 1,212,000 acre-ft for the use of 5,000, 000 persons in Southern Californi from San Diego to Los Angeles.

Three fundamental points of dif ference between California and Ar zona which arise through interpreta tion of the Colorado River Compac and other documents on the Colorad River throw in question 2,000,00 acre-ft.

(*Continued on page 68*)

Extensive Earthfill Dams Remove Threat of Severe Floods at Houston, Tex.

In Barker and Addicks Dams, Lone Star State Lays Claim to Two of World's Longest Earthfill Structures

THIRTEEN-MILE-LONG BARKER DAM (above) is part of extensive Buffalo Bayou flood control project designed to protect Houston, Tex., and surrounding area from severe floods. Designed and constructed by Galveston District of Corps of Engineers, 37-ft-high earthfill structure was completed in 1945 after three years of work. Artist's sketch shows reservoir at flood control height, covering 13,100 acres.

[W]ITH THE HELP OF heavy earth-[m]oving equipment, construction of [th]e 12-mile-long earth embankment [fo]r Addicks Dam is being completed [tw]o months ahead of schedule, in [ti]me to stem floods during the 1948 [ra]iny season. Located about 18 [m]iles west of Houston, Tex., Addicks [an]d Barker Dams are part of the ex-[te]nsive Buffalo Bayou flood control [p]roject designed by the Galveston [D]istrict, Corps of Engineers. The [p]roject will protect Texas' largest [c]ity and Harris County from floods [su]ch as the record 1935 deluge which [c]aused the loss of eight lives and [p]roperty damage estimated at $2,-[5]28,000.

Barker Dam, completed in 1945, is [1]3 miles long with a maximum height [o]f 37 ft forming a reservoir covering [1]3,100 acres. Twelve-mile-long Ad-[d]icks Dam, begun in May 1946, has a [m]aximum height of 48.5 ft, and creates a reservoir covering an area of 11,600 acres. Estimated at a cost of more than $6,000,000, construction of the Addicks project required about 731,000 man-hours.

Much of the 24,700 acres of land purchased by the Corps of Engineers for project right-of-way and reservoir

(*Continued on page 68*)

[L]ARGE DRAGLINES (right) dig Buffalo [B]ayou Rectification Channel to carry flood [w]aters discharged from reservoir formed by Addicks Dam. Structure just completed [u]nder direction of Corps of Engineers is [l]ocated on South Mayde Creek, 18 miles [w]est of Houston, Tex.

[A]DDICKS DAM, EARTHFILL STRUCTURE 12 miles long and 48.5 ft. high (below), is rushed to completion by heavy earthmoving equip-[m]ent two months ahead of schedule for operation at start of 1948 rainy season. Dam is part of Texas' Buffalo Bayou projects.

Century of Progress Marks Many Improvements in Construction of Locks and Dams

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Pittsburgh, Pa.

TRENDS IN PROCEDURES, methods and equipment used in the construction of navigation locks and dams since the early 1800's are highlighted in this article which is based on a paper presented before the Waterways Division at the ASCE Spring Meeting in Pittsburgh, Pa. Although major attention is focused on navigation facilities on the Ohio and tributaries thereof, areas in which the author's personal contact has been concentrated, the trends noted are typical of those experienced in the development of other major United States waterways. The transition from simple earth dikes to the modern interlocking steel sheetpile cofferdams, accompanied by ingenuity in design and use of improved equipment, changes in concrete specifications and methods of placing, and the introduction of accelerated safety programs are reviewed.

CONSTRUCTION of navigation facilities on the many rivers in this country since 1804 has involved an immense volume of labor and materials. This breathtaking program has seen as great a change in method as has been evidenced in any other industry in the country, with extremes comparing favorably with those marking the evolution in transportation from the horse and buggy of the nineteenth century to the automobile of today. Construction methods have of necessity kept step with the changes and improvements in the design of locks and dams.

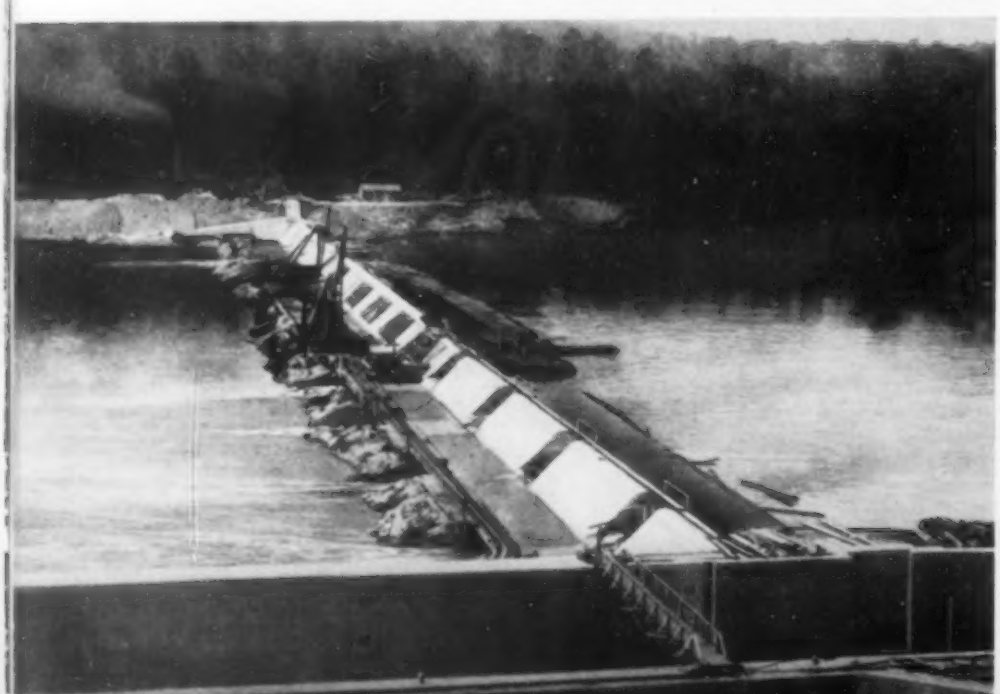
The first and most important problem to be solved preliminary to the start of construction of a lock or dam has always been the determination of the type of structure to be utilized as a cofferdam. This structure must minimize the flow of water into the construction site, permit unwatering of the enclosed area by a rather heavy assembly of pumps, and after unwatering must permit the control of any leakage by a reasonable amount of pumping. The second important preliminary consideration is the protection of the cofferdam against the usual marine hazards of flood, ice and drift, since locks and dams are on active streams and consequently subjected to damage from these forces. The third essential involved is that of economy, so as to provide the least costly installation, ready removal and maximum re-use of materials. Up to 1925 it was not at all uncommon to find cofferdams built only a few feet above the normal river level and to have the job flooded out at the first high water in the fall—often early in November—and thereafter remain in- undated and idle until the low-water season in the spring, sometimes as late as July.

The first and simplest type of cofferdam used on river work consisted of a "dike" of earth, usually compacted and offering considerable obstruction to the passage of water. However, overtopping in time of flood often resulted in the loss of this simple structure. Improvement of the dike structure was effected by the installation of a central cutoff wall of wood sheeting (and later of interlocking steel sheetpiling) and occasionally by the use of a covering of riprap to prevent scour. This type of structure was reasonably adequate for low-head operations, but continued to suffer damage and loss during the periods of vicious high water that occur on most of the country's inland rivers.

Another method of cofferdam construction developed in the early days involved the use of a crib of interlaced timbers, filled with rock to provide stability and sheeted on the outer or river face with tightly engaged wood sheeting of the Wakefield variety. Such structures were subject to certain limitations in cost, depending on the availability of timber, derrick and riprap stone, and tight sheeting material, although they had the advantage of being reasonably durable and safe during periods of high water.

Two Early Dams on Black Warrior River

An early example of this type of rock-filled crib cofferdam was utilized by the writer's company in 1907–1910 for the construction of Locks and Dams Nos. 14 and 15 on the Black Warrior River, built on a contract basis for the Corps of Engineers, U.S. Army. The cofferdams, designed by the Corps of Engineers, consisted of box cribs made up of 6 × 8-in. timbers with the spaces between the timbers covered with 1 × 12-in. boards, placed



FIXED DAM OF 40 YEARS AGO is typified by Dam No. 15 on Black Warrior River, constructed by building first two sections while water passed through third section. During closure of third section of this dam, gaps provided in two completed sections carried river flow—an improvement over previous practice of merely raising height of third section so that water would flow over crest of two completed sections.

ONSTRUCTION OF OHIO RIVER TYPE BOX COFFERDAM involved assembly of sectional framework on barge. As barge moved forward, ucture was allowed to settle into place on river bottom. Sheeting was then put in place and cofferdam was filled immediately, as near to p as possible. Sand and gravel from river provided best fill material.

ngitudinally. The cribs were floated ring their construction and built , one section on another, until the ttom rested on rock. The coffer- m was then filled with earth and ck and decked with 2-in. planks.

Equipment on these two jobs involved a gasoline towboat, several wooden barges which were constructed and launched at the site, a narrow-gage dinkey track, temporary water-to-rail transfer points for cement and other construction materials, small timber stiff-leg derricks, and a timber tower cableway for handling materials across the river. On both jobs it was necessary to open quarries and install crusher plants to provide concrete aggregate and the larger stone embedded in the work. Sand dug from the river and crusher screenings were used as small aggregate for the 65,000 cu yd of concrete placed in the two projects.

Construction practice for the early fixed dams called for the raising to full height of two of the three sections into which the structure was divided while the water was permitted to pass through the remaining third section. Then the final section was closed by a cofferdam higher than the two completed sections, thereby forcing the water to pass over the crest of these sections. On these two dams, however, the closure section was made no higher than the crest of the dam, and gaps provided in the completed sections carried the flow of the river until work had progressed sufficiently on the closure section. To permit final closure of the gaps, which were 16 ft wide by 12 ft high, stop-logs were placed on the upstream side while the concrete was placed. This gap method has been followed on many fixed-dam projects since that time.

FIG. 1. **ACHIEVEMENTS OF CORPS OF ENGINEERS, U.S. Army,** in continuing program for improvement of inland waterways of United States for navigation, are shown graphically on map. Heavy, continuous lines represent open-water streams having 9-ft channels or deeper, and broken lines, streams now providing 9-ft channels by means of locks and dams.

Early Ohio River Type Box Cofferdam

Another and more common type of cofferdam used in the early days, especially on the Ohio River and its upper tributaries, was called the Ohio River type box cofferdam. This structure consisted of two rows of wood sheeting spaced 16 to 20 ft apart, with timber wales on the outside, which were held together by steel rods passing through wales and sheeting.

In the construction of this cofferdam the first operation was to assemble on a barge a framework con-

TWO KINDS OF PLANT ON EACH JOB were required for construction of Ohio River box-type cofferdams—floating plant for use on outside and for building of cofferdam itself, and land plant (frequently submerged during winter) for work inside of structure. Box-type cofferdam was of necessity located considerable distance from work enclosed. Distance varied with character of foundation encountered, since cofferdam ordinarily did not rest on rock but rather on river bottom.

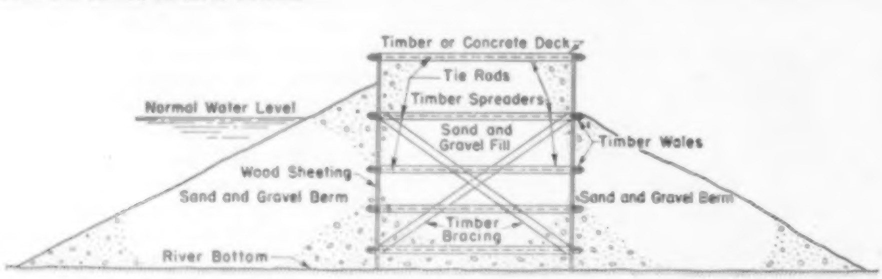


FIG. 2. OHIO RIVER TYPE BOX COFFERDAM, early and common type used especially on Ohio River and upper tributaries, consists of two rows of wood sheeting spaced 16 to 20 ft apart, with timber wales on outside. Wales and sheeting are held together with steel rods.

sisting of the wales, rods, spreaders and bracing, with one vertical sheet of planking at each tier of rods. As the barge moved forward the structure was allowed to settle into place on the river bottom. The remaining space between the rods was then sheeted on each side with 2- or 3-in. planks resting on the river bottom, the size of the planks depending on the depth of the cofferdam, which was filled immediately as near as possible to the top. A berm was then placed on both the inner and outer sides. Sand and gravel as dug from the river provided the best kind of fill and were ordinarily used. In most cases a decking was placed over the top, composed of either 2-in. plank, or a layer of concrete 4 to 6 in. thick, to prevent washing out of the cofferdam fill during periods of high water. It was often necessary to place riprap around the corners to prevent scour inasmuch as stages up to 50 ft could be expected to overtop any cofferdam in the Ohio River.

This type of cofferdam was of necessity located a considerable distance from the enclosed work. The distance between the inside of the cofferdam and the permanent structure varied with the character of the materials encountered, as the cofferdam did not ordinarily rest on rock but on the river bottom.

Use of the Ohio River box cofferdam necessitated the provision of two kinds of plant on each job—floating plant for use on the outside and for the building of the cofferdam itself, and land plant for the work within the cofferdam. The land plant was very frequently submerged during the winter months. In addition to the

THERE IS actually no single phase of the history of construction on the country's rivers that does not present a study in contrasts between the old and the new, even though less than half of one century marks the span between the two extremes. It becomes clearly evident from a review of this history that the construction industry has kept abreast of the times and has maintained healthy competition, technical progress, initiative in labor-management relations, and ability to carry its share of any present or future program in marine construction which may be required for the continued canalization of our inland rivers.

disadvantage of being relatively lo in head, this cofferdam occasionall suffered heavily from high water; i many instances sections were scoure out and lost completely.

Steel Sheetpile Cofferdams Introduced

In an effort to eliminate the h zards resulting from the use of the bo cofferdam, several departures we developed in the years following 192 Such developments were usually i connection with the construction the dam proper, which, being rel tively narrow, could be constructe in short sections and in small coffe dams, whereas the locks were of nece sity constructed in a large cofferda requiring complete enclosure of th area.

Several efforts were made to u internally braced interlocking ste sheetpile cofferdams, and after tw attempts in which the scheme wa abandoned, the method was succes fully applied for the first time at Da No. 23 on the Ohio River. This typ of construction permitted the use floating equipment almost exclusivel with the result that all valuable pla could be removed from the site in tim of flood or ice.

Another innovation resorted t rather infrequently, was the use pneumatic caissons sunk independ ently along the line of the dam, with concrete seal placed between section using the tremie method. Th scheme, which again permitted the u of a relatively small amount of pla and made all parts of the work acce sible to floating equipment, was e tirely successful in the construction Dam No. 32 on the Ohio Rive 1922–1924.

On this particular project, the im practicability of using caissons fo construction of the "beartraps" an beartrap piers led to the use of cellular type of interlocking steel pil cofferdam in which the bases of th beartrap piers and weirs were place by submarine concrete bucket. Ste pile cells were filled with sand an gravel to provide stability. Again i was possible for floating equipment t handle practically all the work, in cluding erection of the beartrap ste

This type of cofferdam was used i spite of the somewhat disappointin experience in the first installation a cellular cofferdam employed in rais ing the battleship *Maine* in Havan harbor, the main difference being th in the cofferdam for the *Maine* th only available filling material, of clayey nature, was used for stabilit and proved unsatisfactory, whereas Dam No. 32, sand and gravel we used for the filling material. Prior t

s use at Dam No. 32, the interlocking steel sheetpile cofferdam had been sed successfully in the construction f the Black Rock Lock at Buffalo n 1914, but did not become generlly accepted until around 1930, artly as the result of experimentation nd improvement by the steel fabriators in the design and rolling of a ore efficient and dependable product.

Dashields Cofferdam Proves Its Worth

Typical of the further development f the interlocking steel sheetpile offerdam was the construction of Dashields Dam on the Ohio River. n 1928–1929 this fixed dam was onstructed within five sections of offerdam, using cells 40 ft in diamter spaced 42 ft from center to center. The 2-ft spaces between the cells were closed by two short arcs of sheetng connected to T-piles in the walls f the cells. The cofferdam used in aising the *Maine* differed in that it mployed a single arc to connect djoining cells, an arrangement which ontributed very little to the stability f the structure.

The Dashields cofferdam was ooked upon by some as an experinent, uncertain of success. Nevertheless, actual experience proved its racticability. The cofferdam, which was driven to rock, provided for a 40-t head of water and permitted coninuous work within the cofferdam ntil the river exceeded a level 8 ft bove normal. Full-revolving whirlrs mounted on top of the concretelecked cofferdam had uninterrupted ccess to the work.

Continuing developments and daptations of this type of cofferdam ave been used on practically all ucceeding lock and dam construcion, thereby permitting a much onger working season, more efficient peration, ready accessibility to the ork, and short reach for equipment.

Another adaptation of the steel heetpile cofferdam is its use as a refinement of the Ohio River box cofferlam but utilizing interlocking steel heetpiling driven to a much greater lepth than was possible with the wood heeting, with tie-rods connecting the wo lines of sheeting. This arrangenent again provides for greater durability, an increased working period wing to stability against higher eads of water, and sufficient strength o take the load of construction equipnent mounted on top of the cofferdam.

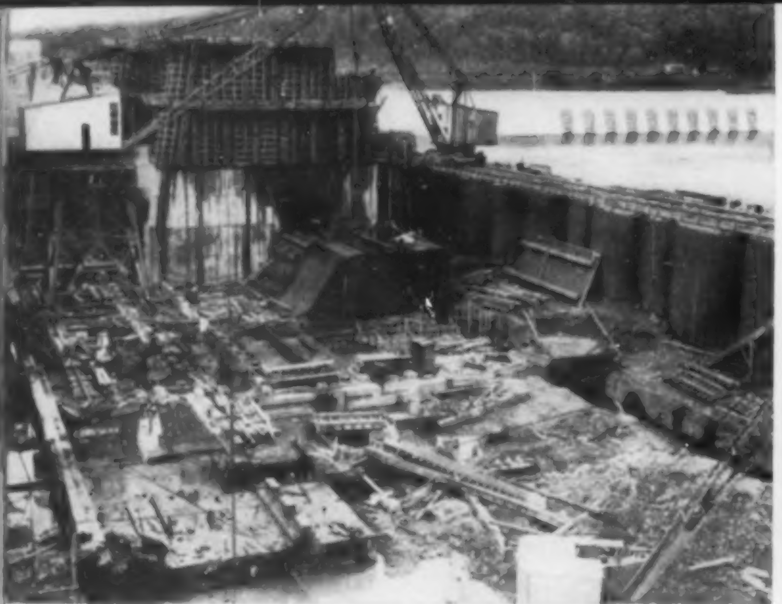
As in the construction of the Ohio River box cofferdam, it has become ommon practice to deck the top of he fill within the majority of cellular r double-wall cofferdams with a layer of concrete approximately 6 in. thick to prevent scour when overtopped by high water. This feature has proved its value over many years, as there have been innumerable instances in which such a cofferdam, filled with sand or sand and gravel, has been scoured clean of its fill material in the course of a single flood, with consequent failure of the structure.

Progress and improvement in the design and construction of cofferdams have been paralleled by similar ingenuity in the design and use of equipment. The use of steel sheetpiling, and especially its pulling and removal, have required longer booms on cranes, greater load capacity, and greater flexibility of operation. The demands of economy and efficiency dictated the use of full-revolving cranes and whirlers of all descriptions. Evolution of the shorter work day from twelve to ten to eight hours required the use of additional shifts—many jobs operating around the clock—and equipment of necessity was constructed to stand the strain of the greatly increased load.

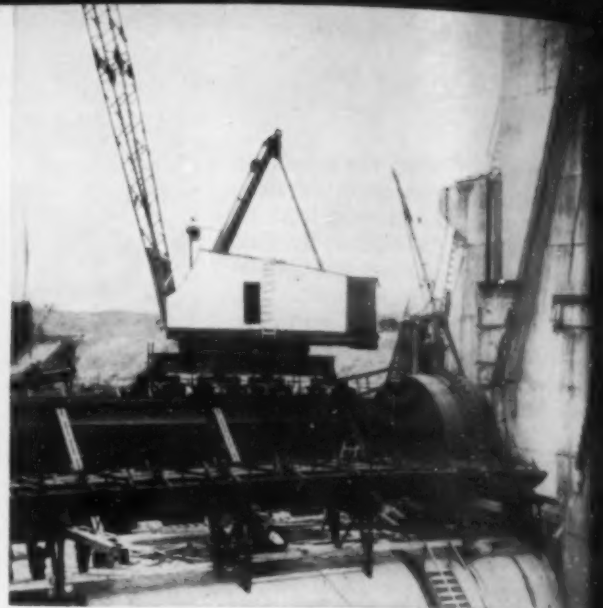
In the earlier locks and dams, cableways played an important part, either for the construction as a whole or for the handling of materials from the shore to the job site. While this method continues in use on many large projects today where concrete volume is large and placing in batches of 4 cu yd or more is feasible, nevertheless the trend on navigation lock and dam construction has been away from the cableway and towards the placing of concrete with individual equipment

FIXED-TYPE DASHIELDS DAM ON OHIO RIVER, built in 1928–1929, marked important development in use of interlocking steel sheetpile cofferdam in that space between cells was closed by 2-ft arcs of sheeting connected to T-piles in walls of cells. Dam was constructed within five sections of cofferdam using cells 40 ft in diameter and 42 ft from center to center. Full-revolving whirlers mounted on top of concrete deck of cofferdam had uninterrupted access to work.

USE OF INTERLOCKING STEEL SHEETPILING in refinement of Ohio River box-type cofferdam permits driving to much greater depths, gives greater durability, lengthens working period (because of stability against higher heads of water), and provides sufficient strength to accommodate load of construction equipment mounted on top of cofferdam.



ALLEGHENY RIVER LOCK NO. 2, built in 1908, is typical of early locks and dams. Most of these structures were of low-head type consisting of concrete slab placed on rock-filled timber crib or on wood piling. Many were carried to rock, but others were on wood or steel-beam pile foundations with interlocking steel sheetpile cut-off walls to prevent flow of water underneath.



MORE EFFICIENT PLANT AND EQUIPMENT, demanded by i proved cofferdam construction methods, includes full-revolvi cranes and whirlers with longer booms, greater capacity and m flexibility of operation. At same time, introduction of shorter w day required use of additional shifts, with many jobs operati around the clock.

in batches not to exceed 2, or at most 3 cu yd. Stiff-leg and guy derricks have given way to full-revolving cranes. Motive power for equipment has been progressing rapidly from steam to electric and diesel to secure greater flexibility and economy of operation.

Pumping equipment for the large cofferdams used on lock and dam construction has always constituted a major problem. Thirty years ago steam-driven engines were belt-connected to centrifugal pumps, mounted either in the bottom of the excavation in successive steps or on pump boats inside the cofferdam. These installations were replaced by electric or gasoline belt-driven centrifugal pumps, and more recently by the vertical electric pump mounted in a rigid frame, making it possible to move the entire unit from place to place and to dry up the excavated area with a minimum of time and expense. It is now possible to dewater a large lock cofferdam in days whereas weeks were formerly required.

Evolution in Mixing and Placing Concrete

In the realm of concrete mixing and placing equipment alone there has been an unusual evolution. The early conception of a proper layout for th purpose was usually a land plant not to exceed 1-cu yd capacity, wi batching by volumetric measure a transfer of concrete by cableway dinkey locomotive. Plant records o Dams Nos. 14 and 15 on the Blac Warrior River indicate the use of "5-ft cube mixer," shaped like a bo which according to an eye witness w very ungainly and eccentric in opera tion. Concrete was transported i buckets by steam dinkey locomoti to A-frame travelers having a 18 deg radius of boom travel.

Evidently this concrete was e tremely dry. The specification though short (with only two pag devoted to concrete), were reasonabl specific and stated in part as follows

"All concrete must be thorough compacted by ramming in layers n exceeding 6 in. in thickness after ram ming. The top of the concrete sha in general be kept as nearly hor zontal as may be during the process placing, one layer being complete before another is started, and laye of concrete must not be run out to thin edge. The rammers shall b made of iron 5 in. × 5 in. on the fac and weighing not less than 20 l The operation of ramming must gi a thoroughly compacted, dense ar ficial stone of high specific gravity."

CONSTRUCTION OF LOCK AND DAM NO. 15 on Black Warrier River marks crude but effective beginning of internal vibration of low-slump concrete. Concrete in this 1912 project remains in good condition today. Later changes in accepted practice saw all concrete hoisted in towers to height sufficient for distribution through intricate system of cable-suspended chutes to various parts of work.

This specification was clearly th crude but effective beginning of i ternal vibration of low-slump co crete, and it is of interest to note th the concrete in these two Black Wa rior Dams continues in good conditio today.

Only a few years later it became th practice to hoist all concrete in tower

a height sufficient for distribution through an intricate system of cable-suspended chutes to various parts of the work. The water content of the concrete was dictated by the "flowability" required to get it from the hopper at the top of the tower to the point of placement. The term "pouring" concrete probably originated from this practice. It was not unusual for the unlucky occupant of the form area below to be deluged with wet concrete from a "plugged" chute high over head.

This extreme logically resulted in a complete reversal to an unusually dry mix. Chutes became out of the question, and direct placement by bucket was again the order of the day. The problem then was how large a mixer could be used economically, how large a bucket could be employed to transport the concrete to the form, and how large a crane would be required for the operation. Floating mixer plants were ideal for many river jobs, with one or two mixers of from $\frac{3}{4}$- to 2-cu yd capacity mounted on a barge. The mixers were fed by semi- or fully automatic weighing apparatus which took material from aggregate and cement bins located strategically above. The aggregate bins were filled by full-revolving cranes mounted on the common hull, and bulk cement was blown pneumatically from barges alongside.

With these developments came the redesign of buckets to permit quick discharge of the batch. While the concept of "dry" concrete has fortunately been modified to a sensible degree in recent years, it is still necessary to improve and alter handling and placing equipment and methods to keep step with changes in concrete design.

Improved Formwork for Faster Schedules

A major item in construction cost, and especially in lock and dam work, is that of forms. Thirty years ago, if one monolith was placed in a 12-hour shift, it was considered a good day's work. Today the construction superintendent is expected to place that same monolith in possibly two hours and to place three more before the end of the 8-hour shift. He must then place four more monoliths during the second shift, and possibly the same number during a third shift. Forms must be built to permit this more rapid rate of placement and yet provide for inexpensive setting and stripping.

This need for speed in form setting and stripping has resulted in the use in two popular types of forms. The first is the complete form unit mounted on a supporting traveler or gantry, from which the side and bulkhead forms are suspended, the gantry moving on track or rail to the next position. The second and more commonly used type is the large slab form, with slabs handled in units by cranes available for other multiple duties such as placing concrete and excavation. Both types of forms are tied together with large tie-rods widely spaced to permit the entry of drop chutes or "elephant trunks" and the larger buckets of concrete, the use of which requires stronger wales, studs, sheeting, etc.

With the transition from low-head to high-head cofferdams, the lock and dam construction industry realized a partially compensating increase in cost due to the fact that generally the high-water period is also the cold weather period, when it is necessary to provide heating facilities for mixing and placing concrete at temperatures below normal, a matter of no importance 20 or 30 years ago. It has now become necessary to heat aggregate in the bins using steam or similar means, and to enclose the form area by either tarpaulins or more permanent means to keep the curing temperature within proper range—and for a considerably longer period than was formerly required.

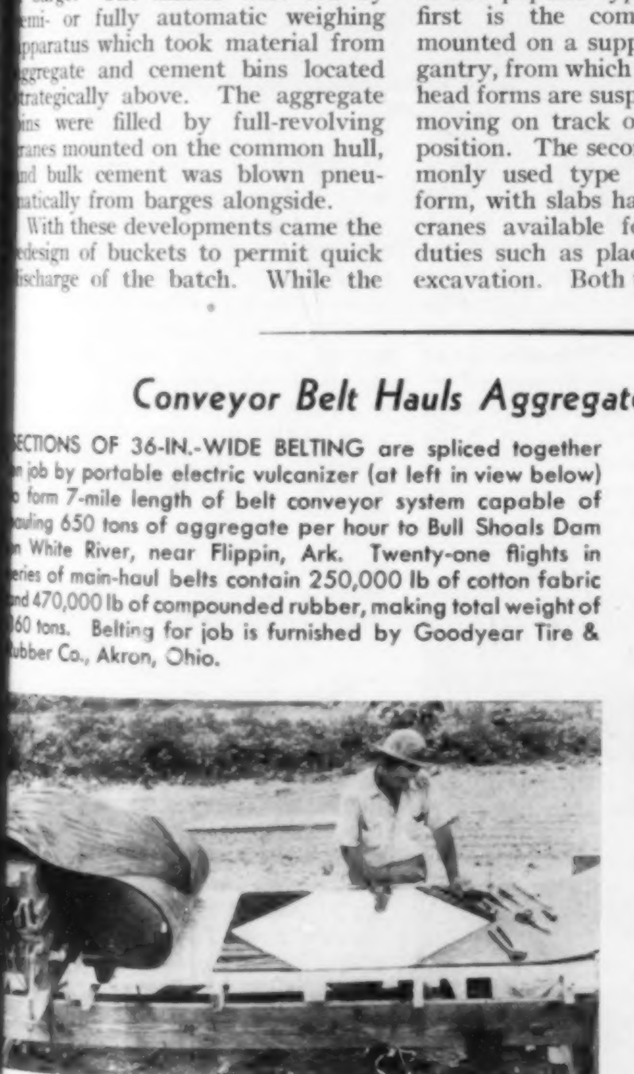
The source of aggregate for concrete on river jobs has always been a matter of intense interest and importance. On the Ohio River and some of its tributaries, it is feasible and possible to obtain sand and gravel from the river bed by proper processing and to transport these aggregates by water to the site of the work. Processing of materials has, of course, changed to a marked degree over the years. In many instances in the nineteenth century aggregates were removed directly from the river bed

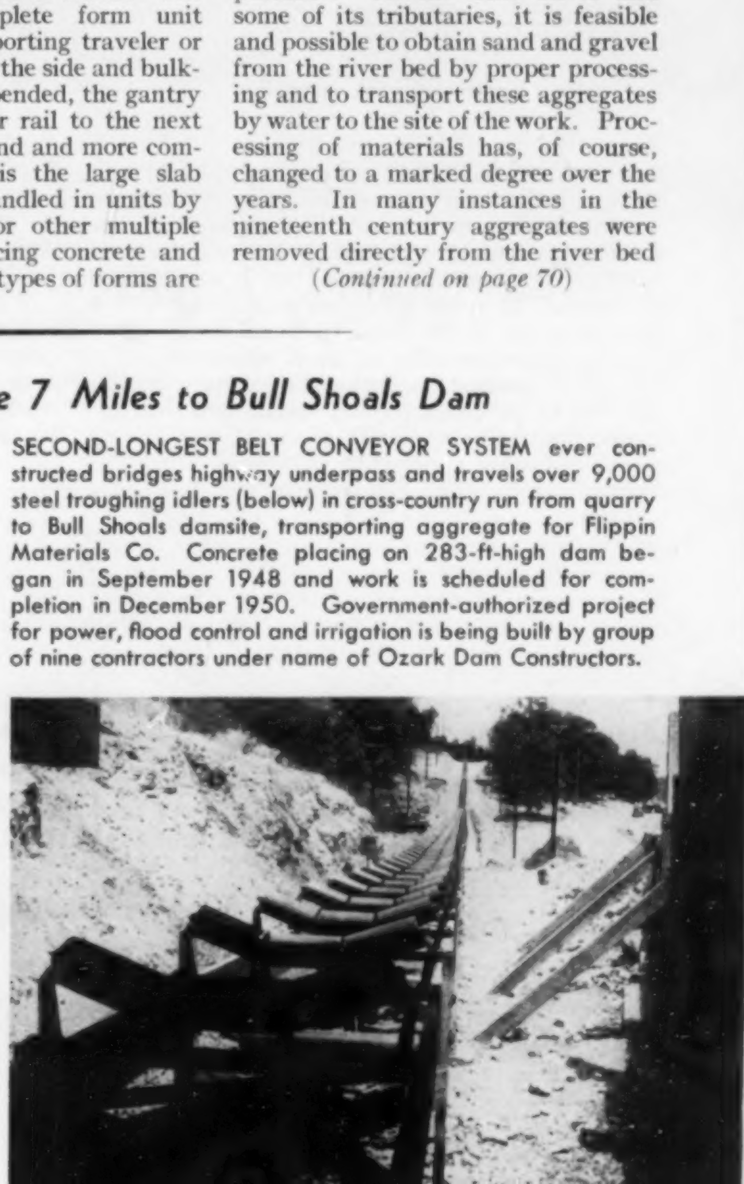
(*Continued on page 70*)

Conveyor Belt Hauls Aggregate 7 Miles to Bull Shoals Dam

SECTIONS OF 36-IN.-WIDE BELTING are spliced together on job by portable electric vulcanizer (at left in view below) to form 7-mile length of belt conveyor system capable of hauling 650 tons of aggregate per hour to Bull Shoals Dam on White River, near Flippin, Ark. Twenty-one flights in series of main-haul belts contain 250,000 lb of cotton fabric and 470,000 lb of compounded rubber, making total weight of 360 tons. Belting for job is furnished by Goodyear Tire & Rubber Co., Akron, Ohio.

SECOND-LONGEST BELT CONVEYOR SYSTEM ever constructed bridges highway underpass and travels over 9,000 steel troughing idlers (below) in cross-country run from quarry to Bull Shoals damsite, transporting aggregate for Flippin Materials Co. Concrete placing on 283-ft-high dam began in September 1948 and work is scheduled for completion in December 1950. Government-authorized project for power, flood control and irrigation is being built by group of nine contractors under name of Ozark Dam Constructors.





Mechanical Trimmer and Slip-Form Expedite Canal Lining Operations

Electrically Operated Machine with Unprecedented 112-Ft Span Lines Over One Mile of Delta-Mendota Canal in Five-Day Work Week

R. H. HEITMAN, Assoc. M. ASCE

Chief Engineer, Western Contracting Corporation, Sioux City, Iowa

TRIMMER AND SLIP-FORM, largest of their type ever built, leave trail of finished concrete lining as they follow course of Delta-Mendota Canal in California's Central Valley Project. Rapid progress made possible by this type of equipment often requires reprogramming of project work.

RAPIDLY INCREASING labor costs have led to the use of large mechanized equipment on many construction operations previously handled by light machines and small tools. An outstanding example of this trend is the development of large trimmers and slip-form machines by Western Contracting Corporation of Sioux City, Iowa—operating in California as Hubert H. Everist, Sr.—for trimming and lining with 4 in. of concrete a 13-mile section of the Delta-Mendota Canal under contract by that firm from the Bureau of Reclamation in the California Central Valley. The success of the plant, method and organization used on this job is best illustrated by the record for canal paving established during a five-operating-day week when slightly over a mile of canal was lined. This performance is the result of proper application of careful, integrated, engineered mechanical equipment specially designed for the job.

PROTOTYPES of the large trimmer and slip-form machines used on a 13-mile section of the Delta-Mendota Canal were developed by the writer's firm for use on a 4-mile wasteway section with a 14-ft bottom width. The small machines furnished valuable information for perfecting the design of the huge machines used in paving the main canal with its 48-ft bottom width, 18-ft depth, 1½-to-1 side slopes and 102-ft top width. The 112-ft gage between rails on this machinery makes it the largest of its type ever built. Photographs and a brief description of the prototypes were published in the September 1947 issue of CIVIL ENGINEERING, page 41.

The unprecedented span of 112 ft presented a major problem in steel structural design as rigidity is essential to cut and form the concrete to a true grade, since the concrete is only 4 in. thick and any slight deviation produces an appreciable loss in concrete. The trimmer weighs 235 tons and the slip-form about 205 tons. The main framework of the machines is an inverted truss, three trusses to each machine. The bottom-chord members are two 12-in. channels back to back on the slip-form and a 12-in. channel box section on the trimmer. All the steel construction is welded except for bolted connections which were required for sectional rail shipment and rapid field assembly. Approximately 17 cars were required for shipping each disassembled machine. The bolted connections also permit the machines to be dismantled for rapid moves around interfering structures.

The great weight of the machine requires the use of 112-lb rail and 8-in.×8-in.×4-ft ties spaced on 20-in. centers for each rail. This fact should be noted by engineers connected with the design of future canals of this cross section or larger, as a berm at least 10 ft wide is necessary for the operation of machines of this size. Present canal design calls for a berm only 5 ft wide at the top of the lined section, which requires a contractor to excavate the extra width and backfill at his own expense in order to leave the cross section as designed on completion of the work.

High Alloy Steel for Wheels

The machines are carried on two two-wheeled trucks on 30-ft centers riding each rail. The extremely high wheel load necessitated the use of a special high alloy steel for the 18-in.-dia wheels. The material now used is alloy LA86, developed by the Warman Steel Casting Co. of Los Angeles and has a Brinell hardness of three times that of the rail ball, which is necessary to prevent flattening of the wheels and spreading of the flanges. A novel departure from usual practice is the use of double flanges on only the front left wheels of each machine

All other wheels are flat and 1 ft wide with no flanges, enabling the machine to easily negotiate the 47 curves on the present project. The wheel design also permits the rail-laying subcontractor to lay track faster because only the left rails need to be accurately lined. The staking and rail laying has been simplified by the Bureau of Reclamation by standardizing on radii of 400, 600 and 800 ft. Rails are not pre-bent for laying around these curves.

Trucks Skewed to Negotiate Curves

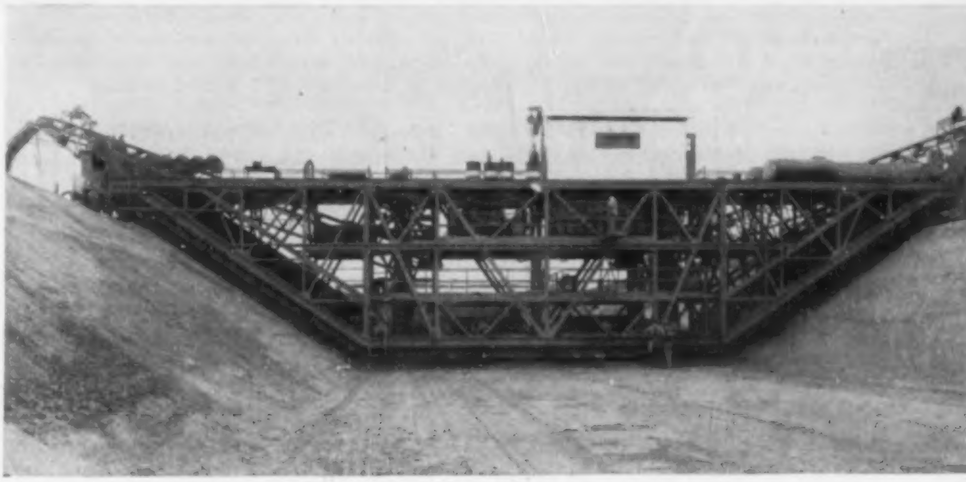
Both rails are set approximately to grade and any rail settlement or grade inaccuracy is corrected by power-operated, hydraulically actuated cylinders transmitting the truss load to each truck. These 15-in.-dia cylinders are the pivot point for the trucks and transmit the load from the truss to the trucks. Each of the flat-wheel trucks has a pin-connected strut running from the truck frame to the main frame of the truss, which is adjustable in length. The rail pressure on the trimmer is so high that these struts have to be adjusted to skew the trucks in negotiating the curves, but on the slip-form, since a considerable portion of the load is carried on the concrete, this adjustment is not necessary and the machine travels around the curves with all trucks square.

One man on each side of each machine guided by a piano-wire line stretched taut by turnbuckles between steel stakes keeps the machines accurately to grade. There is a central, electrically driven pump for the Vickers hydraulic system so that the operators' only duty is that of working two valve levers which actuate the hydraulic cylinders or jacks over each truck. The man at the jack on the flanged wheels steers the machine by operating a variable-speed reducer. This man is guided by a gage which shows him that the machine is square across the ditch or on a radial line when the needle is in the center of the quadrant.

Jackmen control the travel speed of the machines by speed reducers and can vary the rate of travel at any desired increment from 0.6 to 15 ft per minute. By this means the speed of the slip-form can be keyed exactly to the rate of concrete production and the machine can be backed up rapidly or travel past unconcreted sections with a minimum of lost time.

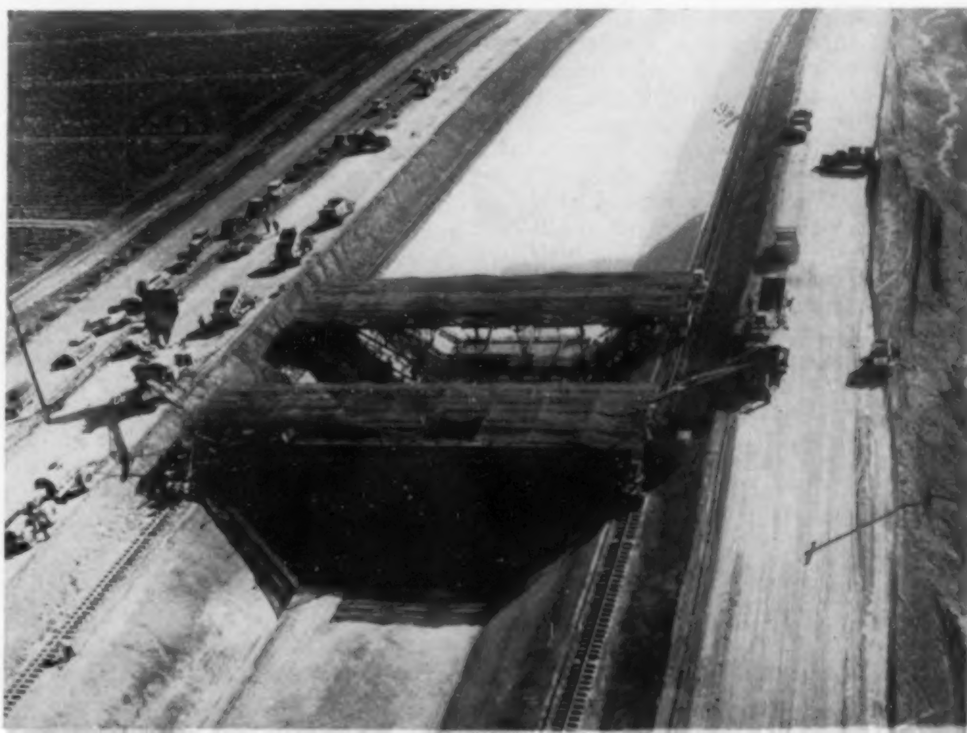
Power for driving the machines comes from one electric motor on each side. The motor is connected to the variable-speed reducer which in turn is connected to an automotive trans-

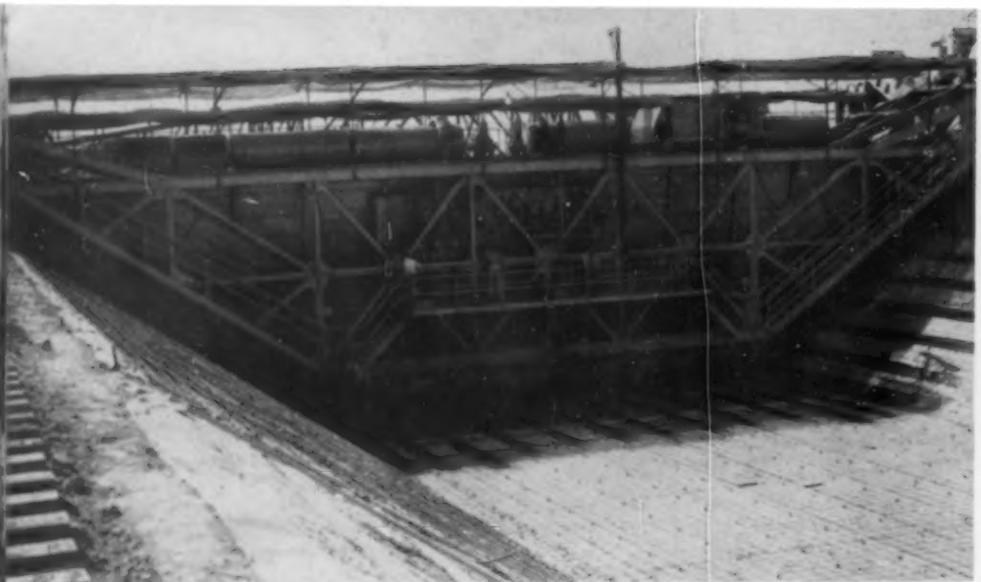
SPOIL BANKS FROM ROUGH GRADING OPERATION (above) are leveled to make room for dirt from 235-ton trimmer and for haul roads on each side of canal. Trimmer loosens dirt by means of cutters, rakes it down slope and across bottom from center by series of transverse plates, picks it up from windrows by bucket elevators located about 5 ft in from toe of each slope, and discharges it on conveyor belts beyond track on each side of cut.



FRONT VIEW OF TRIMMER shows operator's platform (just below housing on top), panel providing complete electrical push-button control of all operations, structural framework, and digging teeth. Spoil material discharges on berm at both sides of canal. Accuracy of canal rough grade in foreground leaves minimum cut for trimmer.

SLIP-FORM AND FINISHING JUMBO (below) in continuous operation construct 4-in.-thick concrete lining on Delta-Mendota Canal. Cart at right end of 112-ft-span slip-form in foreground is in position to receive batch from paver, while cart near left end drops concrete into series of pockets for even distribution along subgrade. Haul road on each side accommodates twin pavers with their retinue of water trucks and batch trucks.





THREE INVERTED STEEL TRUSSES provide main framework for 205-ton slip-form carried on two two-wheeled trucks riding on single rail each side of canal. Front of machine (above) carries operator's platform and control panel for complete electrical operation of machine. Rear view of slip-form (right) shows hydraulic cylinder and wheel truck, diesel-electric generator, water tanks, and surface of concrete as it emerges from behind machine.

mission. The transmission is connected to a reducing gear and thence through a universal joint to horizontal rods running to the trucks. Another universal joint and a worm gear over each wheel turn the wheels. The problem in working out this drive system may be seen from the fact that the reduction at the slowest speed is about 10,000 to 1.

Smooth Cutting Action Secured

Considerable thought and study were given to the type of cutting action to be used on the trimmer to prevent tearing of the subgrade and to provide a perfectly smooth surface. Cutting is done by the reciprocal action of plate cutters with renewable teeth moving parallel to the line of travel of the machine. Cutters are in 14 subassemblies, four on each slope and six across the bottom. Each subassembly is 8 ft long, has its own motor, and contains three cutters. Each cutter has a 2-in. stroke, the speed of which is varied from 160 to 190 strokes per minute to keep the cutters from synchronizing.

Cutters are driven by eccentrics, two to each cutter blade, 120 deg apart, and are lubricated by a Trabon pressure system which oils each eccentric at adjustable intervals, usually set at about $1^1/_2$ min apart. The cutters gently loosen the dirt without any tearing action and are designed to make up to a 1-ft cut although extreme care is taken in finishing behind the rough grading draglines to hold the cut down to 9 in. To assure this accuracy and to make certain that the canal prism is excavated to perfect alignment before the large dragline moves on, one instrumentman is permanently assigned to check the line and grade. The cutters have successfully trimmed cemented gravel by using auxiliary cranes swinging large rakes to scarify the slopes and bottom ahead of the trimmer in order to loosen embedded boulders.

After being loosened by the cutters, the dirt is raked by a series of plates 30 in. wide mounted on D-2 Caterpillar track assemblies down the slopes and across the bottom from the center so that it is windrowed to be picked up by the two bucket elevators located about 5 ft in from the toe of the slope on each side. The elevators discharge onto stackers equipped with 36-in. conveyor belts which empty the material on waste piles on each side of the canal.

The trimmer is electrically operated and completely equipped with pushbutton controls for all operations. The electricity required for the 28 electric motors on this machine and for lighting for night operations is generated by two Caterpillar D17000 (90 kw) and one D13000 (75 kw) generator sets mounted on the machine. Water tanks of 3,000-gal capacity for sprinkling the subgrade ahead are also mounted on the machine as well as an electric welder for making any necessary repairs.

Mix Is Accurately Controlled

The slip-form machine is designed to take the production of a 34E dual-drum highway paver operating on each side of the canal. Each paver discharges into an electrically driven car with hydraulic gates on the bottom, running on rails on top of the machine. Each car operates out to approximately the center of the slip-form and drops the concrete into a series of pockets, 20 on each slope and 12 across the bottom. These pockets are open on the bottom so that the concrete is deposited on the subgrade directly in front of a 54-in.-long "skin" plate which decreases in length up the slope.

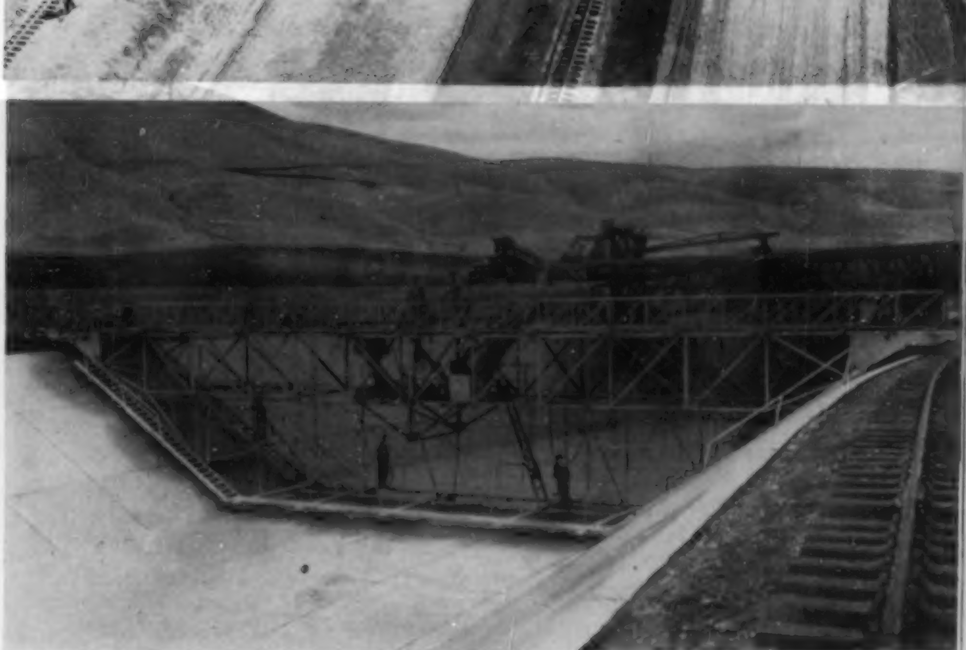
High-frequency, variable-amplitude Syntron vibrators help extrude the concrete from the pockets and under the plate in the required 4-in. thickness. Concrete is held in place by the slip-form for about two minutes and then remains stable on the $1^1/_2$-to-1 slope. Gradation of aggregate at the contractor's screening and washing plant is held to a much closer tolerance than specified since accurate control of the mix is essential in this method of placing.

A uniform slump of 2 to $2^1/_2$ in., which is required for satisfactory placing, is secured by this control of aggregate production and by careful mix design by the Bureau's concrete technicians. An air-entraining agent is added at the mixer, resulting in about 4 percent of entrained air. Hung on the slip-form machine framework about 5 ft behind the skin plate are seven $2^1/_2$-ft-wide by 16-ft-long flat steel press plates which give a troweling action and correct any surface irregularities in the concrete. The plates on the slope are set at an angle of about 9 deg, which tends to force the concrete back up the slope if it is slumping.

The nine $^3/_{16}$-in.-wide by 1-in.-deep longitudinal joints are cut by the press plate. A wheel cutter larger than the joint cross section on the front edge forces the coarse aggregate aside. After the troweling action of the plate has refilled the joint with mortar, a shoe under the back part of the plate forms the joint to the required dimensions. The transverse joints, which are of the same dimensions as the longitudinal joints and

like them spaced on 15-ft centers, are cut by mechanically lowering the walkway hung on the front of a separate self-powered, diesel-electric finishing jumbo. The leading edge of the walkway is made of an angle which is used as a guide by finishers in cutting the joints. The finishing jumbo lags behind the slip-form whatever distance is required to work the concrete at the proper consistency.

Electricity for the eight push-button-controlled electric motors on the slip-form is supplied by two Caterpillar D-4630 motor generator sets. The machine carries 6,000-gal water tanks which add weight to hold the machine down and supply water to the two pavers and to a series of nozzles extending out in front of the machine to wet down the subgrade. Two electric pumps are used on this water system, one to transfer water from the tank supply trucks and the other to keep a constant pressure on the spray system.



JUMBO OF LIGHT TRUSS CONSTRUCTION, preceded by finishing machine (background), supports platform for curing operations. Transverse and longitudinal joints, spaced on 15-ft centers, are seen in foreground. Rail, at right, is job-bent to follow curve in canal.

Contractor-Designed Washing Plant

Aggregates are produced from a local sand and gravel deposit adjacent to the canal by an all-steel portable washing and screening plant with a 25 × 40-in. primary jaw crusher, a 10-ft. × 36-in. jaw crusher and a 24 × 40-in. roll crusher to reduce the oversize material. The washing plant was specially designed by the Western Contracting Corporation. Aggregates are trucked a short distance to stockpiles near the center of the job, and dry batched by a crane-charged, three-compartment aggregate bin. Cement is picked up from a Johnson cement batcher and a 1,500-bbl storage silo by the trucks.

A novel feature of the aggregate batch bin, which was also designed by the contractor, is that it is movable. Each night it can be skidded on rails across the exhausted stock-pile area so as to eliminate any rehandling of material by the one crane and clamshell which moves the material up to the bins. Thus the three sizes of aggregate can be stockpiled from the washing plant well ahead of use. Both of the batching plants have full manual control and their capacity has been proved to be more than enough to supply the two dual-drum pavers.

The project is under the direction of I. L. Gebhard, project manager for the contractor, who also supervised the design and construction of the machines herein described. C. W. Jones, consulting engineer of California, was consultant on the design and fabrication of the machines. Superintendent on the construction is D. G. Hall, Assoc. M. ASCE, and W. F. Boone is engineer. For the Bureau of Reclamation, O. G. Boden is the construction engineer at the Antioch Office, G. C. Imrie is the resident engineer and O. H. Folsom is field engineer.

These machines are now being rebuilt to a width of 129 ft to trim and line the 6.3-mile section of the Main Canal in the Columbia Basin Project near Ephrata, Wash., on which the Western Contracting Corporation was low bidder in August.

Brackish Water Not Harmful in Concrete Mix, Navy Study Shows

INVESTIGATION OF CONCRETE in installations on Midway, Wake, Saipan and Johnston Islands in the Pacific, built during the war years, has led to the conclusion that brackish water of low-degree salinity used in mixes has no apparent adverse effect on the compressive strength of concrete or on the corrosion of reinforcing steel, and is not a direct cause of cracking and spalling of the surface. The following is a synopsis of reports received from advance bases in the Pacific area as reported in the U.S. Navy *Civil Engineer Corps Bulletin*, Vol. 2, No. 21.

Naval Air Station, Midway Island. Brackish well water which was used for all concrete work on Midway Island during the war had an average salinity of 57 grains per gal.

An inspection of existing concrete structures showed the following: (*a*) The present condition of all concrete is good; (*b*) there is no sign of deterioration of the surface; (*c*) there are no serious examples of cracking, crumbling, spalling of concrete, or exposure of reinforcing steel; (*d*) the reinforcing steel exposed by digging into concrete was found to be in good condition with no signs of rusting; (*e*) a search of the files has uncovered no information as to the dates the concrete was placed, or the characteristics of the mixes used, but it is believed that all construction was performed during 1941 to 1944.

The largest concrete job was the underground diesel and fuel-oil system which consisted of four 13,500-bbl steel tanks and four 27,000-bbl tanks and required 4,700 cu yd of reinforcing concrete.

Water was obtained from a brackish well, but usually no water was needed because the aggregate contained so much. Concrete strength was held to 3,000 lb at 21 days; 7 sacks were required, on less important work a 6-sack ratio was used.

Naval Air Station, Wake Island. No extensive concrete construction was employed on Wake. However, two basketball courts and a few concrete quonset decks were built, using brackish water. These items have been inspected and conditions noted as follows: (*a*) Present condition of concrete is poor; (*b*) surface beginning to deteriorate; (*c*)

(*Continued on page 72*)

East Meets West in Controlling China's Yellow River

Modern and Ancient Methods Combined by UNRRA Engineers in Rechanneling War-Diverted Stream

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Consulting Engineer, Palo Alto, Calif.

DATING BACK more than a quarter of a century, the most recent experience of the author in China was as consulting engineer for UNRRA in the Yellow River rechanneling project discussed in this article. Shortly after World War I, Mr. Todd accompanied the late John R. Freeman, a Past-President of ASCE, to China, and served as principal assistant engineer in making surveys and estimates connected with studies of the Grand Canal in Shantung Province. Later, in charge of the American Red Cross work relief program for that province, he constructed 500 miles of motor roads. As chief engineer for the Asia Development Co. of Shanghai, he made investigations and estimates for water supplies, roads and other facilities in north and central China, and built roads and dikes in 16 counties of Shantung Province, beside planning and carrying out a major diversion of the Yellow River. Later he was chief engineer of the China International Famine Relief Commission and planned and carried out various engineering projects, including river control, irrigation, and road building from Mongolia to Yunnan Province. In 1936 and 1937 he was consultant on Yellow River problems for the Province of Shantung and the Chinese National Government through the Yellow River Commission. He also was consulting engineer on flood problems for the American Advisory Committee in China. His numerous technical affiliations include membership in the Association of Chinese and American Engineers, of which he served as secretary for seven years.

PLACING OF 25,000,000 cu yd of earth on a river conversion project is a major engineering task, even by today's standards and with the use of modern equipment throughout the undertaking. How vast and unique was the work of that magnitude done in 1946–1947 in the Provinces of Honan and Shantung by the United Nations Relief and Rehabilitation Administration in diverting the Yellow River back into its original channel from the route into which it had been blasted in 1938 by China's army as a defense against invading Japanese, may be judged from some of the conditions under which the task was performed. Purpose of the UNRRA undertaking was to relieve from flood hazard the nearly 2,000,000 acres of farm land which had been taken out of cultivation by this change of river course and to add some 2,000,000 tons of foodstuffs annually to China's short supply, saving that much import from donor nations. In the major diversion project and general repair scheme for the dikes along the 400 miles from Peking-Hankow Railway Bridge to the sea:

Civil war caused friction and raids that ended in dynamiting of air compressors, bulldozers and trucks, necessitating return to hand drilling and oxcart haulage.

Mules won out over the available trucks, and the large portion of earth and rock hauling in the spring and summer of 1947 was done by mule cart. It was more economical, since there was no breakdown of equipment that could not be repaired readily, while with trucks, spare parts were difficult to obtain. The motor transport section set up by the Chinese could not keep the trucks in repair, and local drivers were too rough on the equipment. The charges that had to be made to keep this motor transport division solvent were nearly 50 percent higher than the cost of mule-cart haulage. Then, too, theft of gasoline, oil, tools and parts all had to be written off. In short, China is not yet prepared to handle efficiently large truck hauling tasks on remote construction jobs and compete with local mules.

While Western equipment assisted in the success of the job, for the time element had to be considered, hand methods prevailed on many parts of the work. For example, the excavating of "leading channels" immediately below the diversion, to start the flow down the old channel again and to inaugurate scour as soon as possible, was done by hand. As many as 40,000 workmen were employed in this part of the project about March 1, 1947. Draglines would have been out of the question because of time and lack of spare parts and trained operators. This part of the work was done chiefly by hand and more quickly. The Chinese also preferred to pack the earth in their main dikes and the earth section of the closure by the use of the 8- or 10-man "flapper" made of stone and weighing about 90 lb. Where work is done in sections, and not uniform in height for a long stretch, this method is found convenient. Though UNRRA had brought in sheepsfoot rollers, they were not used extensively.

On the other hand, of inestimable value were jeeps for handling transport of staff, trucks for hauling flour, with which laborers were paid UNRRA's share of the cost, and for hauling tools, bags and men, as well as rock and earth when manpower was scarce, piledrivers, cranes for loading equipment, power shovels for loading trucks with earth, bulldozers, electric generators for lighting plants and a road grader for upkeep of the earth road.

In June of both 1946 and 1947 there was a peak force estimated at 350,000 workmen for a few weeks. These men were distributed over a 400-mile stretch, and in addition to the difficulty presented by the problem of controlling operations of so many workers over so vast an area, the Yellow River Commission staff found it virtually impossible, in the face of the fact that much of this area was in Communist-controlled territory, to oversee the work except where Nationalist troops were at hand for protection.

Results Called Remarkable

The strange mingling of modern occidental and ancient oriental methods and customs was further exemplified by the use made of the centuries-old local dike repair practices of utilizing willow branches for fascine work and kaoliang (tall millet or sorgum) stalks for revetment to protect earthwork from wash. The UNRRA project was by no means a permanent solution to the Yellow River problem. It is merely a stop-gap project. Yet, despite this fact and despite the antiquated practices to which it became necessary to resort, remarkable results were obtained, and our last inspection trip, late in October 1947, showed that the system was holding well and the

IN ADDITION TO some modern construction equipment such as American crane shown unloading piledriver base (upper left), much of work, of necessity, was done by age-old Chinese methods as shown in other views. Caravan of ox and mule carts (upper right) hauls kaoliang stalks for fascines, etc. Layer of dike fill (above) is compacted with 90-lb stone tamper. Wheelbarrows (left) supplement oxen, mules and trucks on placement of materials for main closure dike.

iversion of the river back to its ld course after an absence of eight ears had been a complete success. y late 1947, the river was under etter control than in 1938, and hough the dike system was not repared to take care of a 100-year ood, it is a matter of record that a ow of 600,000 cfs was experienced uring the course of UNRRA's ork.

China's trouble with her Yellow iver is caused partly by the staggering silt load brought down in mes of torrential summer rains n Shensi Province and adjoining erritory with no adequate insurance gainst the clogging of the main hannel in its upper reaches through he Great Plain or the alluvial fan. ot only should there be better ike protection or revetment work, ut other control measures, including n auxiliary flood channel, have een recommended. Some pertinent uggestions connected with this question are given in "The Yellow River roblem," ASCE TRANSACTIONS, 940. But in the decade immeditely following the publication of that aper in PROCEEDINGS in 1938 neither xtended field investigations nor acual improvements of consequence ave been made, if we except the 946–1947 program of UNRRA.

Costly Diversion

The last major flood caused by the ellow River occurred in June 1938 hen the Chinese army purposely cut the south main dike just north of Chengchow (Chenghsien), in Honan Province, to stop the advancing Japanese army after it had captured the city of Kaifeng and was planning to take Chengchow, 55 miles to the west. There was no time to prepare a system of dikes adequately to control the flow that followed an old channel into a tributary of the Hwai River to the southeast. In 1887 the Yellow River had broken its south dike north of Chengchow, about the same place the military chose to divert it in 1938, so there was no difficulty in getting a fairly dependable channel scoured out the first year. It was costly to farmers and villagers though they had been warned to flee. The strategy worked well for the Chinese army and stopped the Japanese advance, holding them back of this new course for six years. But the Chinese peasantry paid a high price in the following eight years that the river meandered over a broad band of agricultural land.

Eight years of war with a foreign invasion that caused the Chinese farmers to desert their lands by the millions and move west, meant deterioration in many ways. Chinese morale dropped decidedly. The country was practically bankrupt. The river bureaus were broken up and badly staffed. There was discontent in the country and revolution was brewing. No one seemed to have the heart to tackle a difficult river job that would be full of political tangles. So UNRRA was invited in with the understanding that China would do her utmost to get this river back into its old channel to the northeast, thereby relieving nearly 2,000,000 acres of farm land from flood hazard, thus adding annually about 2,000,000 tons of foodstuffs to the world's supply.

UNRRA Sends Engineering Staff

UNRRA was invited to send engineering staff to act as "advisers," and bring in large quantities of Western equipment and supplies, including piling and timbers for trestle, lumber for camp, steel cables, rope, sandbags, wire, oil, gasoline, etc. It was UNRRA's responsibility to furnish sufficient technical staff to see that all Western equipment was suitably handled, at least until Chinese operators could be trained. The project was in charge of the Yellow River Commission which recruited and handled all common labor and local materials. This commission, in turn, worked under the National Conservancy Commission that furnished the money for its staff, the local materials and all wages for labor in excess of the $2^1/_2$ lb of flour given by UNRRA to each workman daily.

With this setup and a civil war beginning, UNRRA tackled the job in early 1946. The gap in the south dike at Huayuankow, Honan, was 5,000 ft wide. There was no good bottom to be found for stabilizing

PILING, STRINGERS, CAPS AND BRACES from Oregon form backbone of main closure.

a rockfill or to hold a pile trestle in position against heavy scour. Often a stratum of fairly tough clay or hardpan is found on which to build a closure structure as was the case in West Shantung in 1935. Here successive flood flows for eight summers had so scoured the new bed and filled it back with unstable material that the problem of holding the bed in position was a real one. The Chinese engineers agreed to the method of a pile trestle with rockfill, as was used in East Shantung in 1923 when a trestle 800 ft long was sufficient. The writer planned on a trestle 1,200 ft long for this closure, but the Chinese insisted on making it 1,600 ft and reducing the earth dike closure section to 3,400 ft in length. This plan was adopted, but it increased the quantity of rock so that it was impossible to stabilize the whole width by a submerged loose rock weir sufficiently to carry the high water that came unexpectedly in late June 1946 and the still greater flow of 600,000 cfs that came in late July of that year. A middle section of the pile trestle had to be sacrificed and redriven in November and early December 1946.

Rock was quarried 50 miles to the north and brought in by standard-gage railway over the Peking-Hankow Railway plus an 8-mile spur built by the Yellow River Commission to bring rock and American supplies to the construction site. American portable air compressors with jack-hammers supplemented hand drilling, and for a time good steel dump trucks did the hauling from quarry to railway siding—one to two miles. But civil war caused frictions and raids that ended in dynamiting of air compressors, bulldozer and trucks. We went back to hand drilling and ox-cart haulage from quarry to train and managed to keep production going fairly well. Maximum delivery from rock piles at the end of the trestle into the 1,600-ft-long rockfill dam reached 2,700 cu yd per 24 hours. Here hand-pushed small cars on 24-in.-gage track were supplemented by 100 new steel dump cars with gasoline locomotives that pulled trains of 30 cars per trip across the trestle.

This relief came in December 1946, when float ice had become a problem, and mechanized equipment was a distinct aid in overcoming difficulties and delays.

In spite of military and political troubles that were frequent, the closure was effected in March 1947 when a flow of about 30,000 cfs had to be turned. Leakage was practically all sealed off by the end of April and the work of adding height and width for safety was completed in the following 60 days without incident.

Piling Secured from the United States

The piling was procured from Portland, Ore., and was of good quality in lengths from 50 to 70 ft. The timber for caps to the four pile bents, the 3 × 12-in. bracing between piles, and the 6-in. planking for carrying the light railway all came from Oregon. No concrete was used in this structure, but 2,000,000 sandbags were employed along with 150,000 cu yd of rock, 3,500,000 cy yd of earth, 20,000 tons of kaoliang stalks, 50,000 tons of willow branches, 60 tons of galvanized iron wire, 1,000 tons of hemp rope, 1,000 Oregon pine piles and all the essential pine timbers for making a substantial working trestle 28 ft wide, with bents spaced 10 to 14 ft apart.

Chinese workmen were soon trained to use electric drills to speed up boring holes through piles and timbers for bolting on the bracing. They handled our 8-lb hammers well for driving the drift-pins to hold the caps. The team of skilled Chinese workers from Shanghai handled the engi[nes] skillfully for hoisting the pili[ng], driving piles and moving the hea[vy] skid-type drivers to a new positi[on] after a pile was driven. But alwa[ys] a foreign superintendent, usually [an] American, was in immediate charge [of] this work. There were no serio[us] disagreements between Chinese a[nd] foreigners, and no strikes. The pil[es] were driven to a penetration of fro[m] 25 to 45 ft in the rather soft riv[er] bottom, but to avoid splinterin[g] conical steel points were made [in] our shops by local blacksmiths, the[se] being placed on the carefully shar[p]ened points of most of the pil[es]. This trestle job took less than fo[ur] weeks, from late May until June [2x,] 1946.

In handling a similar closure pr[oj]ect in 1923 in eastern Shantung, t[he] writer was fortunate in doing t[he] job with a trestle 800 ft long, usi[ng] only 40,000 cu yd of rock, 300,0[00] jute bags with the river down [to] 16,000 cfs. Then, too, the conditi[on] of the river bed was more stabl[e]. But in this 1946–1947 undertakin[g] higher water was expected and e[x]perienced (600,000 cfs in late Ju[ly] 1946), softer bottom was inevitab[le] because of the eight years of sc[our] and fill, and costs of materials a[nd] labor had risen to double or tripl[e]. The plan that had worked so w[ell] in 1923 was again adopted and a sim[i]lar trestle built, but experience [in] West Shantung in 1935 had taught t[he] advantage of using the willow-sto[ne] "sausages." These were employed e[x]tensively in the winter of 1946–19[47] when the idea of a broad rockfill [of] uniform top elevation was abandone[d] for the "contraction" method. Th[is] was because of unusually high wat[er] in late fall and winter that contin[u]ally undermined the rockfill causi[ng] settlements that could not be co[n]trolled well enough to permit trains [to] run safely over the trestle. At tim[es] short sections of the trestle move[d] downstream a foot or more, thoug[h] penetration of the piling had be[en] over 25 ft.

As the headwater rose with the a[d]vancing fill in January 1947, it w[as] necessary to use cages of heavy wov[en] wire matting to contain the roc[k]. These had never previously been use[d] on the Yellow River, but America[n] Army supplies made it possible to g[et] enough of this wire mesh to constru[ct] many hundreds of these cages whic[h] were placed on small push cars, fille[d] with small rock (up to 50-lb chunk[s]) near the end of the trestle, and tran[s]ported for dumping into gaps whe[re] swift water was undermining the fi[ll]. These stayed in place well and su[...]

lemented the willow-stone "sau-ges" that had to be anchored back o three or four bents of the trestle to revent their being carried down-ream. Filled cages weighed 500 to ,000 lb.

Dike Checks Leakage

The final closure was effected March 10, 1947, with leakage through he rock and willow fill totaling per-aps 100 cfs. This was mostly cut off y the end of April by the device of uilding a loop dike in front, using illow branches and kaoliang stalks s a core and filling between that uter dike and the main dam with andbags and loose earth brought in y wheelbarrows, trucks and narrow-age railway. Bulldozers and sheeps-oot rollers helped speed up this ork. Hand work and machine ork were combined here satisfactor-ly. Then the mules won out over the rucks and the large portion of earth nd rock hauling in the spring and ummer of 1947 was done by mule art. It was more economical. The harges that had to be made to keep his motor transport division solvent were nearly 50 per cent higher than he cost of mule-cart haulage. Large ruck hauling tasks on construction obs in China, such as this along the ellow River, cannot yet compete ith local mules.

In the matter of rock production, hree portable air compressors with ackhammers, under the direction of n experienced American, established ew Chinese records at the quarries 5 miles north of the Yellow River at uwangfen. The 20 steel dump rucks did fast hauling from quarry to ailway siding, a distance of one to wo miles. But after local raids by rmed bands in connection with the ivil war destroyed compressor, air ose and trucks, quarrying reverted o hand drilling and ox-cart hauling, ut managed to get along pretty well. n soft limestone rock, with the new rill-steel furnished the local quarry-en, good headway was made with and methods.

For many months the average orking force was about 5,000 men, mostly unskilled except in the use of shovels and wheelbarrows. But with these, at the closure, were always a few hundred men who had worked for years on Yellow River dike repairs and knew the local practices in use of willow branches for fascine work and kaoliang stalks for revetment to protect earthwork from wash. For many weeks in early 1947 this working force averaged 10,000 men daily. In the rush of dike repair work—in June, 1946 and 1947—there was an estimated force of 350,000 workmen for a few weeks each year. Many years of dike upkeep have served to train local men so that in each county bordering the river it is possible to find workmen with local skills who have been in charge of dike work. Our airplane investigation from the closure work, 400 miles to the sea on August 21, 1947, showed remarkable bank and dike revetment results obtained by the local organizations under general direction of the "Border Government" and its River Bureau. Lacking boats to transport stone long distances, they had burned bricks and used old stone and brick from city walls, temples and wrecked buildings. Even tombstones were used as emergency rock. The "Border Government" guarded these dikes day and night through the summer high water.

FASCINE "SAUSAGES" developed during closure near Shantung in 1935 are again used for final closure in 1947 UNRRA project.

Paid in Flour

To the closure work UNRRA contributed 5,000 tons of flour as partial wages to workmen. For the entire project, including the diking system, 25,000 tons of flour were given. UNRRA'S total contribution in staff, materials, equipment, etc., was $5,000,000 (U.S.), of which $3,000,000 went into the closure work. China's contribution was fully double that. The total man-days employed amounted to 15,000,000, of which 3,500,000 went into the closure section. On the total job 25,000,000 cu yd of earth were placed in dikes on repairs and replacements and raising the height in low sections. American picks, shovels and wheelbarrows helped equip the 350,000 workmen that were engaged at the peak of the work, but for the most part the people were able to furnish their own hand tools. Rural China has recuperative powers, and under strong leadership and fair treatment the Chinese show great ability to perform teamwork. This is especially true along the Yellow River where the fortunes of 50,000,000 people are influenced by suitable control of this rather unpredictable stream.

When peace eventually is firmly re-established in China, the control of the Yellow River, under a comprehensive plan worked out by engineers who have known the region and the

(*Continued on page 70*)

ON STONE TRANSPORT DUTY. Junks returning to quarry dock upstream on Yellow River, as the Huayuankow closure nears completion.

NCSBEE Reviews Ramifications of Interstate Registration at Salt Lake City Meeting

N. W. DOUGHERTY, M. ASCE
Dean of Engineering, The University of Tennessee, Knoxville, Tenn.

OFFICIAL DELEGATES FROM 38 states and representatives from ten national engineering societies attended the Twenty-Seventh Annual Meeting of the National Council of State Boards of Engineering Examiners held in Salt Lake City, Utah, August 26 and 27, 1948.

Excellent preparation made it possible to go through a long agenda and finish all business on the second day of the meeting. Three persons deserve special credit for the smooth running convention: Executive Secretary T. Keith Legaré, M. ASCE, who distributed printed copies of the reports of many of the standing committees; George M. Shepherd, of Minnesota, president of NCSBEE, who did a masterful job as presiding officer; and Prof. A. Diefendorf, M. ASCE, chairman of the local committee on arrangements, who scheduled programs of entertainment for the two evenings and a bus trip for Saturday afternoon.

Why the Convention?

Professional registration is more than a listing of qualified practitioners; it is a part of the larger movement of professional recognition. Listing competent practitioners is a protection to the people of the states against the charlatan, the shyster, the quack and the faker, and at the same time it forges a chain of unity and solidarity in the profession itself.

During the last 50 years, pioneer activities have changed from claiming the land and discovering new minerals to improvements in methods of production and distribution. New frontiers are made by research and invention in an industrial society. Urban populations need the protection of competency and the practitioners need public understanding and public esteem. Legal status gives the professional man a weapon to fight the interloper and at the same time to build public respect for his good name.

Report of the Meeting

When the federal government was formed under the Constitution, the states reserved the right under their police power to regulate the professions. No national professional registration is possible. The 48 states and the territories of Alaska, Hawaii and Puerto Rico have enacted registration laws. Obviously the theme of the meeting was the many ramifications of interstate registration. At the business sessions on Friday morning and afternoon, committees reported on uniform procedures and uniform qualifications.

Uniform Laws and Procedures

This year the Committee on Uniform Laws and Procedures began a study of enforcement methods in the several states; it will continue the study until information is accumulated from all the states. The committee report concludes:

"Once again, no law is any better than its enforcement. The engineering profession will never attain the recognition it deserves until the laws governing the practice of engineering and the use of the term 'engineer' are strictly enforced."

It should be added that along with enforcement there must be a reasonable amount of uniformity from state to state.

Registration by Endorsement

This year the Committee on Registration by Endorsement made a study of interstate registration of persons who had previously qualified in a state by examination and a study of others who had qualified by presentation of education and experience. The following sentence from the committee report states the problem of the engineer as he passes from one state to another: "The greatest nuisance or mental hazard in interstate registration is the requirement of a written examination."

Eight states reported that they would register, without further written examination, an applicant who had previously passed an examination. Some of the remaining 40 states qualified their acceptance; some did not answer. The committee concluded the report as follows:

"The foregoing enumeration reveals more than sufficient variety to satisfy the most ardent disciple of confusion.

"Obviously the logical procedure is to seek greater uniformity and simplification. All the essential requirements can be covered in a consistent rational manner by adopting two *simple rules:*

"1. Waive written examination in the case of any Registered Professional Engineer who has previously passed a reasonably equivalent written examination given by another state board.

"2. Waive written examination in the case of any Registered Professional Engineer of long-established practice and standing upon acceptable certification or verification of his record of qualifications."

The National Bureau

The report of the Committee on the National Bureau of Engineering Registration evoked more discussion than any other report. Two things were apparent—first, the bureau and its activities were not understood, and second, some of the states were afraid the bureau was usurping some of their functions.

In 1932 the NCSBEE set up the National Bureau of Engineering Registration as a fact finding and certifying agency. It cannot register any one and it does not have authority to issue a license or to authorize anyone

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New Officers Elected for NCSBEE

Alexander, Blair, M. ASCE, Florida, President
Clarence L. Eckel, M. ASCE, Colorado, Vice-President
Paul E. Jeffers, California, Director
N. W. Dougherty, M. ASCE, Tennessee, Director
Walter W. Graf, Ohio, Director from a previous election
Russell, G. Warner, Connecticut Director from a previous election
T. Keith Legaré, M. ASCE, South Carolina, continues as Executive Secretary

DAYTONA BEACH, FLA., was selected as the meeting place for 1949. Dates are November 3, 4, 5, 1949.

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to practice engineering. Registration is a function of the state boards, but they can, in reviewing applications under their laws, consider as evidence the findings of the National Bureau.

Persons registered in any state may present their educational and experience qualifications to the bureau and if, on review, it is found that the applicant has met the qualifications set up by the National Council, a certificate of qualification is issued. This certificate may be presented to any other state board as evidence; its value will be determined by the law and the practice of the several states.

From the discussion it appears that some applicants consider a certificate as a form of national registration. This of course cannot be, and such information is furnished to all applicants with the statement that federal or national registration is not possible. Probably the desire for interstate registration causes some certificate holders to magnify the value of the certificate.

The bureau is trying to be of service to the states rather than to usurp any legal prerogatives. Again in the information pamphlet this fact is made clear by the following statement: "All state boards . . . reserve the right to take whatever action they deem necessary to conform to the requirements of their laws."

During the 16-year period from 1932 to 1948, the bureau has certified 1,080 engineers. This is about 1 percent of the engineers now registered. No doubt several thousand other engineers have achieved interstate registration in the many other ways that are open to them.

Engineers-in-Training

The classification of engineer-in-training was developed during the heyday of the Wagner Act and was designed to serve two objectives—first, to earmark a beginning professional as an arm of management, and second, to start the young engineer in the early stages of registration. At the present time the second objective is the major objective. The Committee on Engineers-in-Training sum-

(*Continued on page 70*)

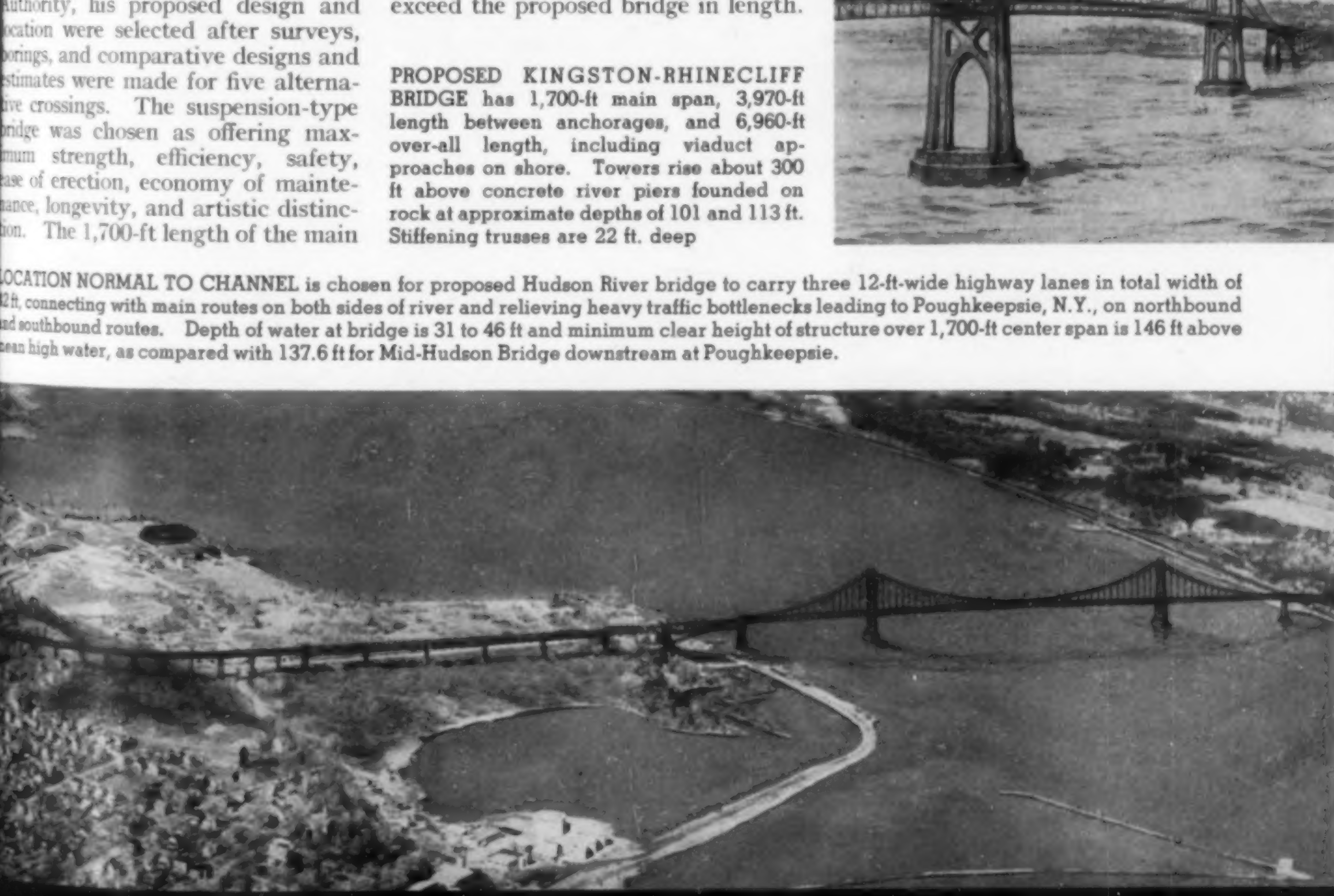
Plans Advanced for New Suspension Bridge Across Hudson

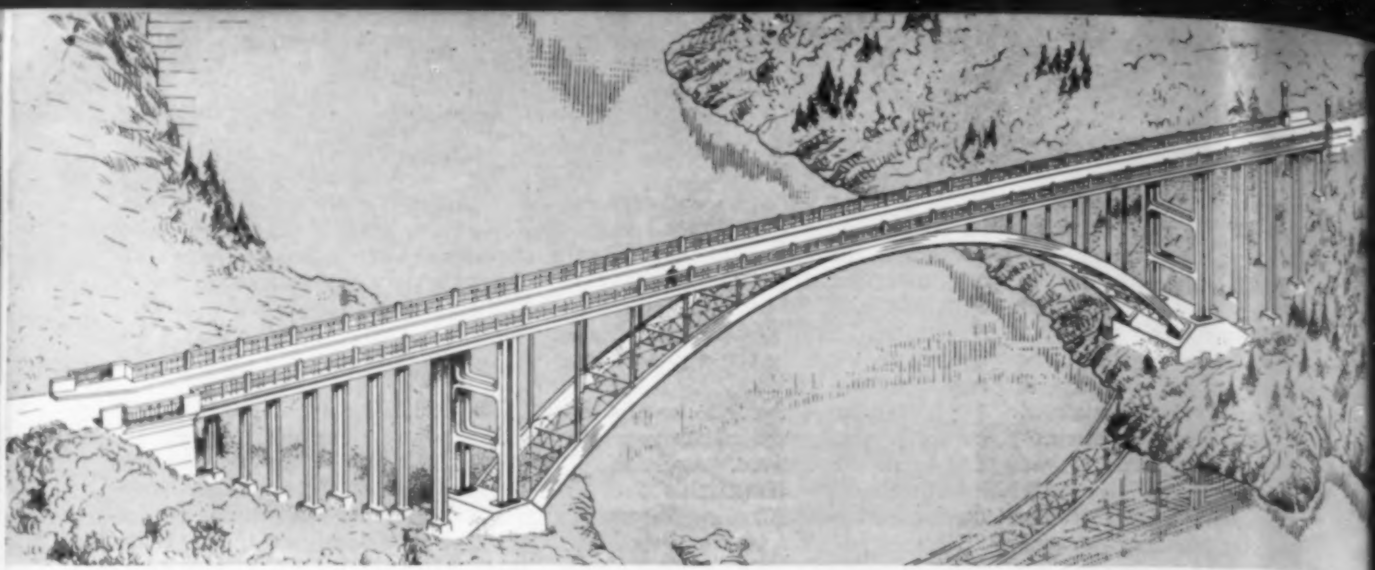
PLANS FOR the Kingston-Rhinecliff Bridge proposed $14,000,000 structure to span the Hudson River between Kingston Point and a point about a half mile north of Rhinecliff Station of the New York Central Railroad, have been submitted by the New York State Bridge Authority to the U. S. War Department for approval.

According to the preliminary report drawn up by D. B. Steinman, M. ASCE, consulting engineer for the Authority, his proposed design and location were selected after surveys, borings, and comparative designs and estimates were made for five alternative crossings. The suspension-type bridge was chosen as offering maximum strength, efficiency, safety, ease of erection, economy of maintenance, longevity, and artistic distinction. The 1,700-ft length of the main span is identical with that of the Firth of Forth Bridge in Scotland, the longest span outside of North America. Only six bridges in North America have longer spans: Golden Gate (4,200 ft), George Washington (3,500 ft), San Francisco–Oakland Bay (two 2,310-ft spans), Bronx-Whitestone (2,300 ft), Ambassador in Detroit (1,850 ft) and Quebec (1,800-ft cantilever). Of the six existing spans across the Hudson River, only the George Washington Bridge will exceed the proposed bridge in length.

PROPOSED KINGSTON-RHINECLIFF BRIDGE has 1,700-ft main span, 3,970-ft length between anchorages, and 6,960-ft over-all length, including viaduct approaches on shore. Towers rise about 300 ft above concrete river piers founded on rock at approximate depths of 101 and 113 ft. Stiffening trusses are 22 ft. deep

LOCATION NORMAL TO CHANNEL is chosen for proposed Hudson River bridge to carry three 12-ft-wide highway lanes in total width of 42 ft, connecting with main routes on both sides of river and relieving heavy traffic bottlenecks leading to Poughkeepsie, N.Y., on northbound and southbound routes. Depth of water at bridge is 31 to 46 ft and minimum clear height of structure over 1,700-ft center span is 146 ft above mean high water, as compared with 137.6 ft for Mid-Hudson Bridge downstream at Poughkeepsie.





WORLD'S FIRST ALL-ALUMINUM highway bridge, over Saguenay River in Canada, has 290-ft-long arch span with rise of 47 ft 6 in. center. Roadway, 24 ft wide, is of precast slab construction. In addition to reduced maintenance costs due to non-corrosive character metal, use of aluminum in this bridge saves 400,000 lb in weight over comparable steel structure, resulting in lower freight rates, simplif foundation work and easier erection.

All-Aluminum Highway Bridge to Span Saguenay River in Canada

Structural Aluminum Finds Application in Bridge and Crane Construction

LESS THAN A CENTURY AGO aluminum was ranked among the world's most precious metals, but with the development of improved methods of separating it from the bauxite ore it has been gradually removed from that category and made available for an increasing number of everyday functions. Governed in choice of material by economic considerations, the Canadians will erect the world's first all-aluminum bridge—across the Saguenay River between Arvida and Shipshaw. At Arvida also, another "first" in aluminum construction is being realized—an all-aluminum overhead traveling crane of 15-ton capacity, about to be installed in the rod mill of the Aluminum Company of Canada. Details of these developments in the use of aluminum are presented here. An all-aluminum test span incorporated in the Grasse River Bridge near Massena, N.Y., was described by Shortridge Hardesty and J. M. Garrelts, Members ASCE, in the December 1946 issue of "Civil Engineering."

WHEN THE CITY COUNCIL of Arvida, Quebec, Canada, recently gave its approval to the construction of a new bridge to span the Saguenay River between Arvida and Shipshaw, it initiated what is believed to be the first all-aluminum highway bridge of its type in the world. The Dominion Bridge Co. of Montreal has been given the contract to construct the bridge and work is now under way. Consulting engineers for the city of Arvida are Surveyor, Nenniger & Chenevert, Montreal. Aluminum fabricators are the Dominion Bridge Co., Ltd., of Lachine.

Large Reduction in Weight Gives Variety of Advantages

Engineers assigned to the project were guided in their choice of aluminum by many factors other than the desire to be known as the designers of the world's first all-aluminum bridge. For example, the bridge, with an over-all length of 504 ft from abutment to abutment, will weigh only 400,000 lb, whereas a similar structure of steel would weigh about twice as much. This reduction in weight saves a substantial amount in freight charges, simplifies foundation work and facilitates erection. Very little maintenance will be required to keep the bridge in A-1 operating condition.

The main span will be of fixed-type arch construction, with a length of 290 ft from center to center of skewbacks, and a rise of 47 ft 6 in. on the center line of the arch rib. There will be five approach spans at the north end and the same number at the south end. The roadway, 24 ft wide between curbs, is flanked by a 4-ft sidewalk on each side.

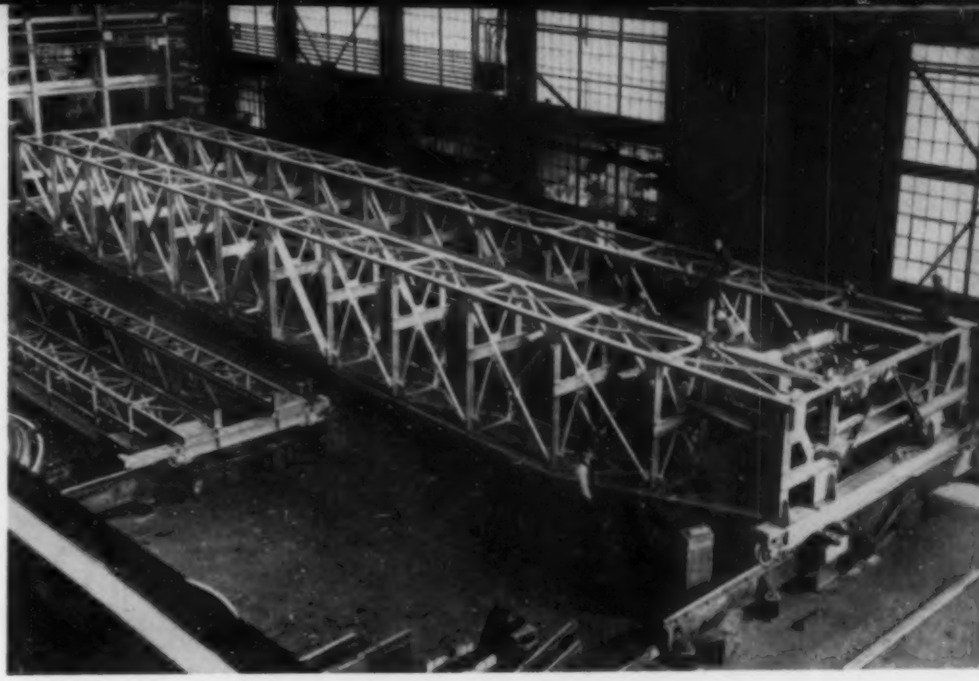
Designed to conform to the spe fications of the Canadian Standar Association for highway bridges a those of the Department of Pub Works of the Province of Quebe the structure has a specified live lo of U 100, or two 20-ton truc abreast.

This Saguenay bridge will be co structed of Alcan 26-ST alloy alum num. The main arch section w be composed of two aluminum we plates 54 in. wide by $^{9}/_{16}$ in. thi with four angles $6 \times 4 \times {}^{1}/_{2}$ in. a two cover plates $32 \times {}^{3}/_{4}$ in.— forming a closed box section. Al of aluminum will be the hand railin and the approach pylons at the sou entrance to the bridge.

Deck and sidewalks are to formed from precast concrete sl sections. Reinforcing steel projec ing from the slabs will be welded the field and the units grouted t gether to form a continuous leng over the bridge between expansi joints. The roadway surface w consist of an asphalt wearing cour placed over the concrete slabs.

Crane Also Fabricated of Aluminum

Another recent adaptation of alum num is one in which the metal used in the structural members of overhead traveling crane about be installed at Arvida, in the rod m of the Aluminum Company of Ca ada. Designed and fabricated by t Dominion Bridge Co., the crane



LALUMINUM BRIDGE CRANE of 15-ton acity is assembled for testing in Lachine nt of Dominion Bridge Co. Girders 97 ng are composed entirely of high-strength minum alloys, extruded in shapes of chans and angles, and rolled into plates. ets and bolts are also of special alloyed minum. Total weight of 51,735 lb comres with 94,000 lb for similar standard ne in steel.

the lattice-girder type with a liftg capacity of 15 tons.

Although the strength of the alumim alloys used is approximately the me as that of structural steel, eper girders were needed in using e lighter metal to prevent excessive flection. To conserve headroom e trolley rails were attached to the side faces of the girders so that the olley would not extend above their p surfaces. This and other feares of construction are seen in the companying photograph.

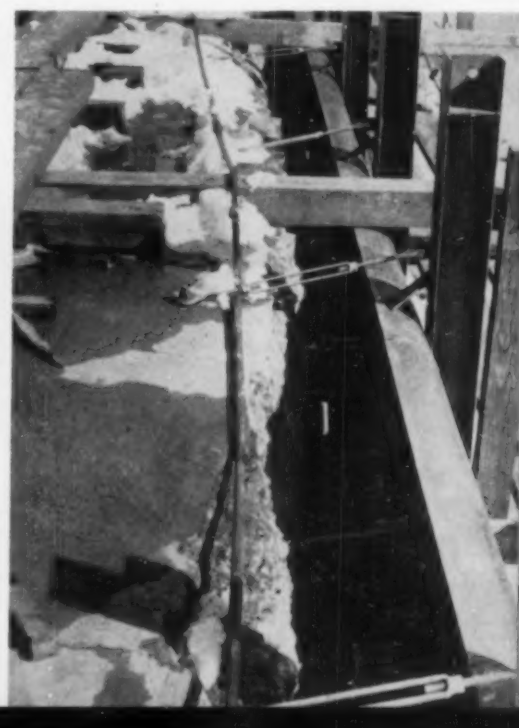
Large Saving in Weight Effected

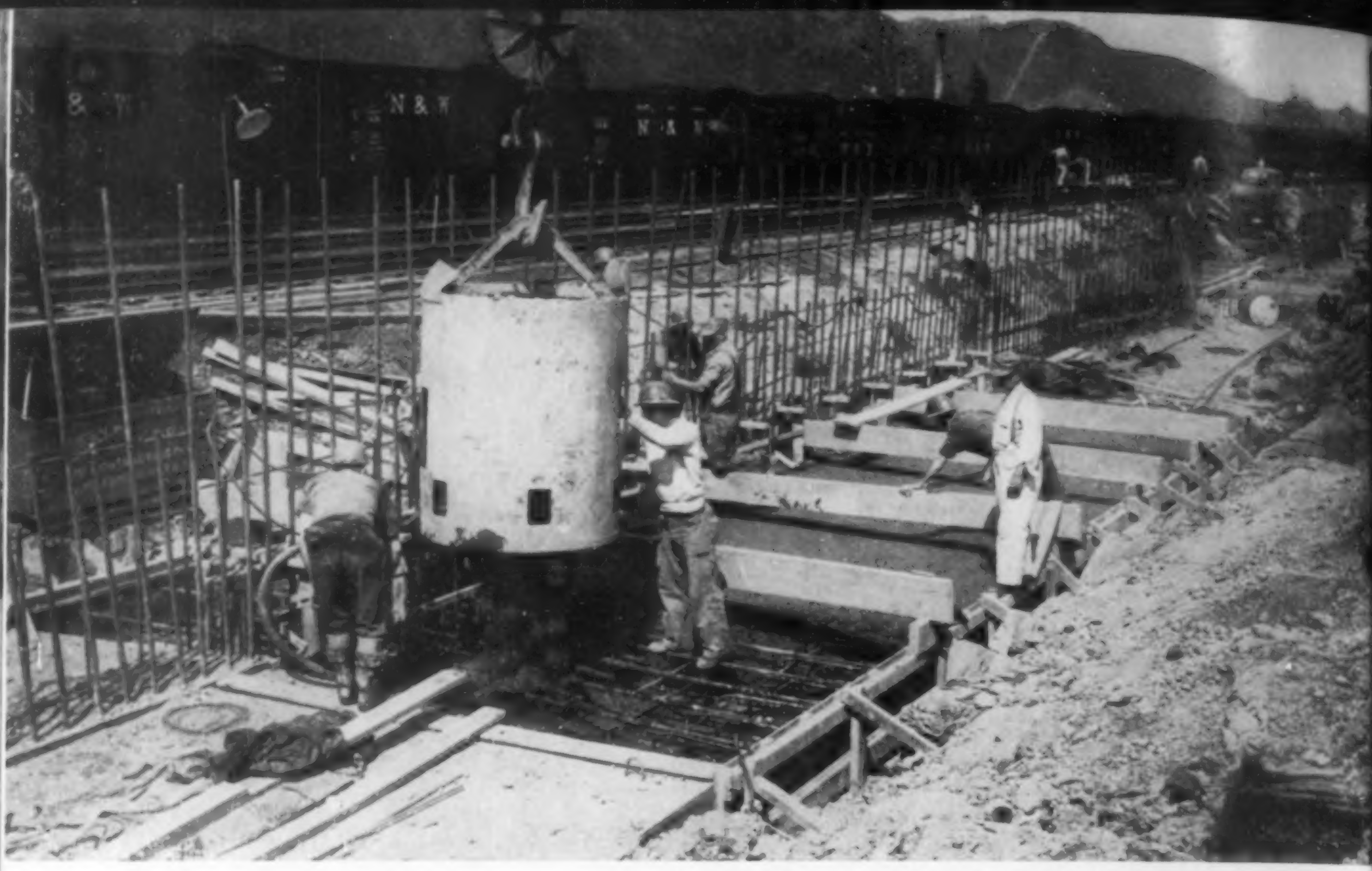
The weight of a standard crane bricated in steel would have been ,000 lb; the actual weight of the uminum crane, complete, is 51,735 . As a result of this considerable ving in weight, it was found possible to install a motor of 30 percent less horsepower than that required for a standard crane. A reduction in the weight of the supporting steelwork was also found possible. Maintenance will be simple and inexpensive since the crane will not require painting.

Extensive research was required before this unusual project could be started. A great deal of joint experimental work was carried out by the technicians of the Aluminum Laboratories and the Industrial Engineering Department of the Dominion Bridge Co. Riveting techniques in particular received a great deal of attention with the result that interesting data concerning this comparatively new material were collected. The knowledge acquired in pioneering this project will be of value to engineers in increasing the uses of structural aluminum.

Wrought-Iron Plates Protect Spalled Lock Wall

DLY SPALLED CONCRETE of wall in Lock No. 24 of the w York State Barge Canal is removed during winter onths and repaired by sheathing in protective coat of ought-iron plate. Repair work on north wall, built in 1908, nsists of removing about 1 ft of concrete by dynamiting, taching plates by cinch anchors and wrought-iron bolts, then ckfilling with fine sand concrete mixture. Wrought-iron ates, ⅜ in. thick, cut in 6 × 36-ft sections at plant of Joseph T. Ryerson & Son, Inc., Buffalo, are fastened together by continuous weld and placed by crane (below, left). I-beams are temporarily attached to outer face to facilitate handling and aligning during installation. Tops of plate sections (below, right) are bent on 2½-in. radius, and on 6-in. radius at ladder recesses in walls. Plates are installed so that joints are in same position as original concrete joints, thus making plate sections integral with original concrete sections.





CONCRETE for flood-wall footing is placed by crane and bottom-dump bucket. Dowel steel for stem wall projects from 20-in.-thick center section of footing.

Gantries Move Forms in Assembly-Line Construction of Flood Wall

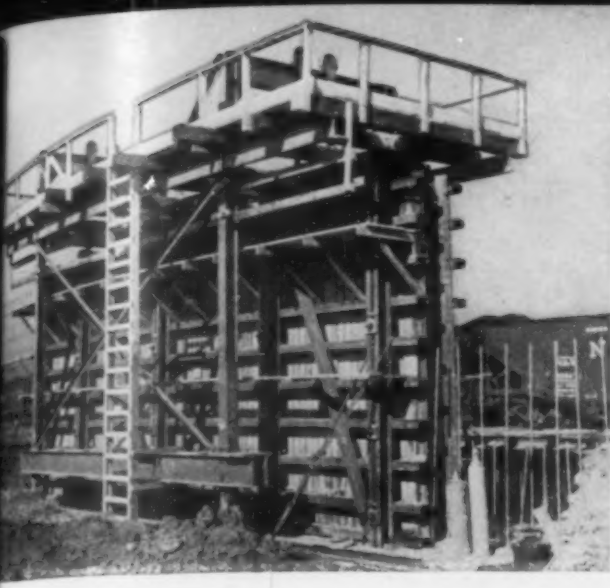
ASSEMBLY-LINE methods for constructing a 7,290-ft concrete flood wall on the Ohio River at Portsmouth, Ohio, featured the use of gantries for handling four sets of stem-wall forms, each 40 ft long and 18 ft high. Two winches powered by electric motors moved each form and gantry on tracks laid on the flood-wall footing. The project was planned by the Corps of Engineers, Department of the Army, and construction was under direction of the Cincinnati District Office. The form-handling feature described here was developed by the Contracting Division of Dravo Corporation, Pittsburgh, Pa.

The new Portsmouth flood wall consists of a concrete key wall, a slab footing and a stem wall. The key wall extends $5^1/_2$ ft below the footing on the river side. Most of the footing is 18 ft wide, 16 in. thick at the edges and 20 in. thick at the center below the stem wall. The stem wall extends 17 ft 4 in. above the footing, raising the top 3 ft above the crest of the highest flood waters of 1937. The wall has a top width of 18 in., is vertical on the river side and is battered 1 in. in 36 in. on the land side, making the wall 24 in. thick at the base. The entire wall was built in 40-ft monoliths except at the corners where special forms were necessary. All construction joints above the footing were provided with cork expansion material. A continuous copper water stop was placed in the wall, footing and key-wall joints.

The earthfill for the footing foundation was firm and compact. In areas where the foundation material was unsuitable, it was removed and replaced with compacted yellow clay. The weather was a major factor in scheduling the work. A slight shower usually stopped operations because of mud produced in the footing areas. Although the total annual rainfall was only 2.60 in. more than average, it rained 139 days of the 293 working days. Drying often delayed work two or three days after a shower.

The four main stem-wall forms were built at the job site. They were constructed of vertical 2-in. wood sheeting, faced with $^1/_8$-in. steel plate, backed by steel frames consisting of horizontal ship-channel studding 4 ft long, with vertical, double ship-channel wales 18 ft long. Round

TRENCH FOR TOE DRAIN is excavated on land side of wall. Earthfill under footing is well compacted to provide firm foundation to prevent seepage and resist overturning from flood pressure. Reinforcing steel for 17-ft 4-in.-high stem wall is seen at left.



GANTRIES, OPERATING ON LIGHT RAILS and straddling stem-wall steel (above left) handle four sets of forms in continuous concreting operation. Forms designed for pressures produced by placing concrete at rate of 5 vertical ft per hour permitted pouring at double that rate or filling to full height of wall in $1^3/_4$ hours. Forms showed no signs of deformation and produced exceptionally fine looking surface. Concrete from mix plant at site, transported to point of pouring in 1-cu yd bottom-dump buckets (above, right), is placed by means of mobile crane. Completed section of wall (left foreground) is enclosed in canvas for curing.

high-tensile form rods $1^1/_2$ in. in diameter were used, with cardboard sleeves to permit removal. Bulkheads for the stems were of 2-in. lumber built in sections that were easily removable. They were held in place with wooden wedges and steel angle clips welded to the stem forms. The lead form was equipped with two bulkheads, the rear intermediate form and lead intermediate form had one bulkhead each, and the closure form, between the two intermediate forms, had no bulkheads, as required by the procedure followed in the alternate use of the forms.

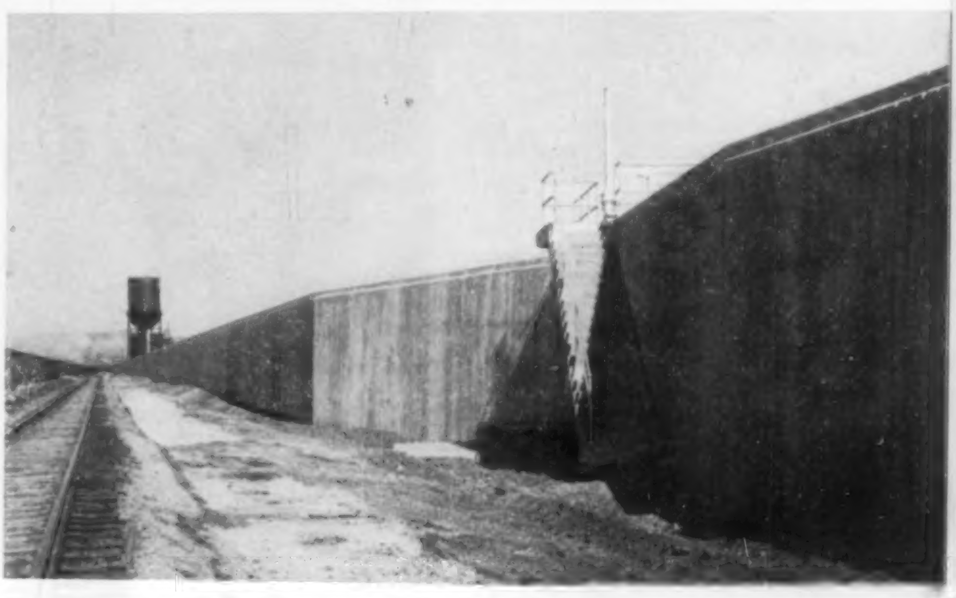
To accelerate setting the forms, line was set by placing one lead plug on each end of the footing $2^3/_4$ ft off the center line of the wall on the vertical side. These plugs were set shortly after the footings were concreted so that variations in the 2-in key for the stem could be checked in advance and trimming done if necessary. The bottoms of forms were blocked into position on this key, with the plumb side first set on line and the battered side pulled into place.

Electric motors were used on the winches in moving the forms because they applied power more uniformly and much faster than would be possible by hand. Moving a form 160 ft usually required an hour.

All concrete was mixed at a plant near one end of the wall. Concrete was transported on $1^1/_2$-ton dump trucks, each hauling a 1-cu yd concrete bucket. Eight trucks were usually required to haul the concrete to the far half of the wall and six trucks for the near half. A crane lifted concrete buckets from trucks and placed the concrete in one of the four chutes provided with each form. Each wall section contained approximately 45 cu yd of concrete.

ORDER FOR PLACING 40-FT-LONG MONOLITHS is worked out to obtain most efficient use of forms. At turns in wall where standard form cannot be used, other forms are constructed and ready at proper time to maintain pouring sequence.

COMPLETED FLOOD WALL 7,290 ft long, planned by Corps of Engineers and constructed under direction of Cincinnati District Office, is designed to protect Portsmouth, Ohio, from tremendous property damage caused by recurring floods on Ohio River.



Laboratory-Developed Concentration Processes Bolster Iron Ore Reserves

DURING THE WAR YEARS, average annual shipments of iron ore from the Lake Superior region were nearly double the average for the previous 30 years, and average annual shipments in each of the five war years exceeded by 30 percent even the peak tonnage years of the past. These heavy shipments make economical concentration of lower-grade ores necessary in order to conserve our reserves of high-grade, direct-shipping ores. The Oliver Iron Mining Co., a subsidiary of the United States Steel Corp., has established a new ore research laboratory in Duluth, Minn., which will engage in a long-range study to develop commercially useful concentrating methods for taconite, wash and intermediate ores.

DRILL CORE OF TACONITE, representing definite location in ore body, is shown as it is received at laboratory (at right in view). Core is split endwise for closer examination (left), one-half being stored for future reference and other half used for series of tests.

CONCENTRATION OF IRON ORE involves, essentially, the economical removal of silica and minor gangue materials from the ore as mined, to increase the valuable iron content of the ore for shipment. Open-pit and underground iron mines in the Lake Superior region have heretofore been located at sites where natural processes have concentrated the iron-bearing minerals by leaching out the silica in the original rock.

The original hard-rock formation of the region has been given the generic name of taconite. However, taconites vary widely in chemical composition, nature and distribution of the iron oxide particles in the rock, and other inherent characteristics. This formation is of vast extent as compared with sources of direct-shipping ores, and will provide a reliable source of iron ore for literally hundreds of years, when proper concentration methods are applied. The new ore research laboratory of the Oliver Iron Mining Co. will engage in experimentation that will ultimately develop suitable processes.

Concentration Processes

Wash ores can be concentrated by removing the excess silica in a relatively simple process of washing the mined ore, with little preliminary crushing. The intermediate ores have their iron-oxide and silica contents more intimately associated, and require both crushing and washing to remove the excess silica. Taconite, on the other hand, is a compact, siliceous rock that must be crushed and then ground to very fine particle sizes, approximating the fineness of ordinary cement (minus 200-mesh), before the iron-oxide particles can be separated sufficiently from the silica and gangue material.

Taconite ore bodies are explored with drills that permit extraction of cylindrical cores, about 5 ft in length and 1 to 3 in. in diameter, progressively, from the test hole. The series of cores from a test hole, in their proper sequence, provide a complete picture of the types of material penetrated by the core drill at a given location. Each core is carefully identified as to where it was obtained.

One test of importance consists in microscopic study of the sample to determine its mineralogical constituents, their mode of occurrence, relative grain size and particle distribution, with particular reference to accessory iron minerals other than oxides (iron silicates, for example) in so far as the latter may interfere with concentration processes.

Since the iron-oxide particles in taconite may be either highly or weakly magnetic, two types of separations may be considered—magnetic separation and froth flotation. If the batch tests show promising results, an experimental pilot line, called a "flow sheet" by the industry, having an hourly capacity of perhaps 100 lb, will be set up to study specific phases of concentrating methods and to establish the value of the particular ore under study as a source of iron.

Data from a large number of core samples from a specific ore body are studied statistically to estimate the value of deposits in the area under consideration. In conjunction with the results of the batch laboratory tests, these data determine whether or not large-scale tests should be performed. The large-scale pilot plant tests are then varied to develop the best beneficiating method for the particular class of ores represented by the sample. The next step is to transfer operations to a pilot plant at the ore site, which leads eventually to full-scale operations at the mine.

The processes of ore concentration developed in the new laboratory will assure the United States of self-sufficiency in iron ore supply for a very long time, and aid in conserving the high-grade ores.

LARGE-SCALE SAMPLES from promising areas are run through "flow sheet" in pilot plant for continuous recovery of iron minerals from finely divided ore at new research laboratory in Duluth, Minn. Tests lead to full-scale operations at mine.

Engineers' Notebook

Dimensionless Constants for Hydraulic Elements of Open-Channel Cross-Sections

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UNIFORM FLOW PROBLEMS can be solved quickly by the use of curves for "conveyance," a term defined by Prof. Boris A. Bakhmeteff, Hon. M. ASCE.[1] Non-uniform flow surface profiles can be determined rapidly by using dimensionless constants in conjunction with Professor Bakhmeteff's varied-flow-function tables. In this article dimensionless constants applicable to trapezoidal and rectangular channels are derived and given for conveyance, critical depth, critical slope and the hydraulic exponent (another term defined by Professor Bakhmeteff). For a given cross section, all these constants are shown to be functions of the depth-width ratio only, that is, they are the same for geometrically similar cross sections.

The letter symbols used herein (Table I) conform essentially to American Standard Letter Symbols for Hydraulics (ASA-Z10.2-1942), prepared by a committee of the American Standards Association, with ASCE representation and approved by the association in 1942.

Derivation of Formulas

1. **Conveyance.** Conveyance is given the symbol K by Professor Bakhmeteff and is defined by the formula:

$$K = AC\sqrt{R} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

[1] *Hydraulics of Open Channels*, B. A. Bakhmeteff, Engineering Societies Monographs, McGraw-Hill, 1932.

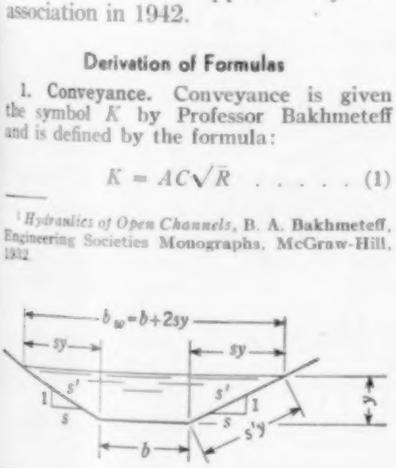


FIG. 1. DIAGRAM OF TRAPEZOIDAL CHANNEL gives nomenclature for derivation of formulas.

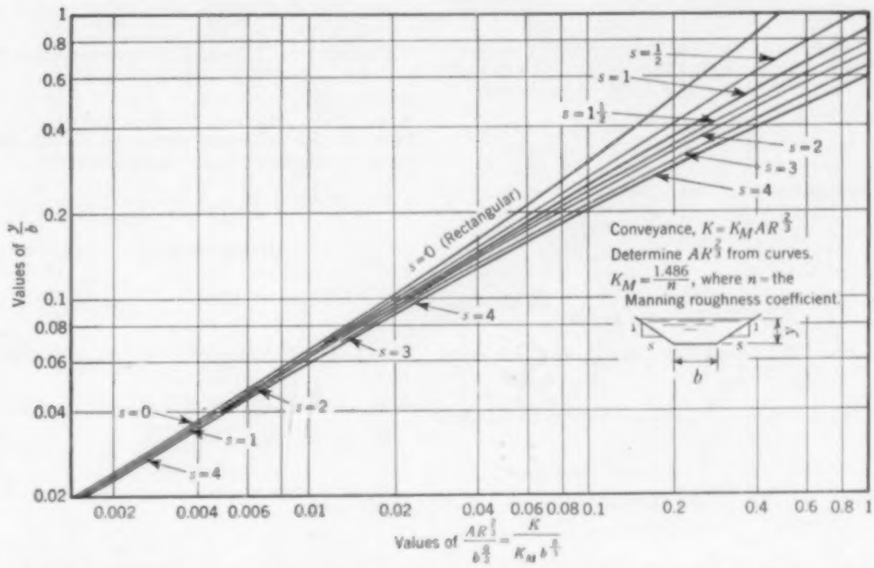


FIG. 2. VALUES USED IN DETERMINING K, conveyance in rectangular and trapezoidal channels, are plotted as computed from Eq. 3.

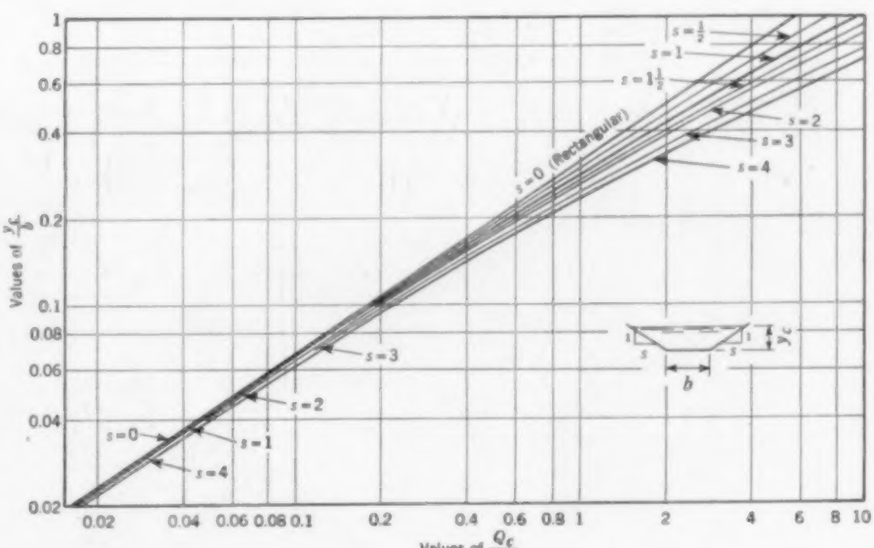


FIG. 3. CURVES FOR DISCHARGE at critical depth in rectangular and trapezoidal channels are plotted for foot-pound-second system of units.

TABLE I. NOTATION USED IN FORMULAS

A	area
b	bottom width
b_w	top width
C	coefficient in Chezy formula
g	acceleration of gravity
K	conveyance
K_0	conveyance for uniform flow
K_M	$1.486/n$
n	roughness coefficient in Manning's formula
n_B	the hydraulic exponent
p	wetted perimeter
Q	discharge
Q_0	discharge for uniform flow
Q_c	discharge at critical depth
R	hydraulic radius
s	side slope of trapezoidal channel (1 vertical on s horizontal)
s'	length of side slope of trapezoidal channel $(\sqrt{1+s^2})$
S_0	slope of channel bed
S	slope of energy grade line (friction slope)
y	depth of flow
y_c	depth of flow for critical discharge
y_0	depth of uniform flow
α	depth - width ratio $= y/b$
σ	critical slope

If the Manning formula, $C = \frac{1.486R^{1/6}}{n}$, is used, Eq. 1 becomes

$$K = \frac{1.486AR^{2/3}}{n}, \text{ or } K = K_M AR^{2/3}. \quad (2)$$

An expression for $AR^{2/3}$ will be derived first. Referring to Fig. 1, $A = by + sy^2$, $p = b + 2s'y$. As $R = A/p$,

$$AR^{2/3} = A\frac{A^{2/3}}{p^{2/3}} = \frac{(by+sy^2)^{5/3}}{(b+2s'y)^{2/3}}.$$

Substituting αb for y,

$$\frac{AR^{2/3}}{b^{8/3}} = \frac{[\alpha(1+s\alpha)]^{5/3}}{(1+2s'\alpha)^{2/3}}.$$

From Eq. 2, $\frac{AR^{2/3}}{b^{8/3}} = \frac{K}{K_M b^{8/3}}$. Therefore

$$\frac{K}{K_M b^{8/3}} = \frac{AR^{2/3}}{b^{8/3}} = \frac{[\alpha(1+s\alpha)]^{5/3}}{(1+2s'\alpha)^{2/3}}, \quad (3)$$

which is a dimensionless expression involving the conveyance K.

Values of $\frac{K}{K_M b^{8/3}}$ have been computed from Eq. 3 and are plotted in Fig. 2. For a given channel, if $\alpha(= y/b)$ is known, read $\frac{K}{K_M b^{8/3}}$ from Fig. 2. Then

$$K = \frac{K}{K_M b^{8/3}} K_M b^{8/3}.$$

Example 1: Determine the conveyance, K, at depths of 5 ft and 10 ft for the trapezoidal channel shown in Fig. 5 (b), with $n = 0.030$. Determine also the uniform flow depth, y_0, for a discharge of 10,000 cfs if the bottom slope, S_0, equals 0.0005.

For $y = 5$ ft, $y/b = 5/100 = 0.05$; $\frac{K}{K_M b^{8/3}} = 0.007$ from Fig. 2.

$$K_M = \frac{1.486}{0.030} = 49.5;$$

$$b^{8/3} = 100^{8/3} = 216{,}000;$$

$$K = 0.007 \times 49.5 \times 216{,}000 = 74{,}900.$$

Similarly, for $y = 10$ ft, $y/b = 0.10$, $\frac{K}{K_M b^{8/3}} = 0.0227$,

$$K = 0.0227 \times 49.5 \times 216{,}000 = 242{,}000.$$

To determine y_0, first compute $K_0 = Q/\sqrt{S_0} = 10{,}000/\sqrt{0.0005} = 447{,}000$.

$$\frac{K_0}{K_M b^{8/3}} = \frac{447{,}000}{49.5 \times 216{,}000} = 0.0418.$$

From Fig. 2, $y_0/b = 0.141$. Then $y_0 = 0.141 \times 100 = 14.1$ ft.

2. Critical Depth. A general expression for the critical discharge[3], Q_c, is

$$Q_c = A\sqrt{\frac{A}{b_w}}\sqrt{g},$$

which for a trapezoidal channel becomes

$$Q_c = y(b+sy)\sqrt{\frac{y(b+sy)}{b+2sy}}\sqrt{g} = b^{5/2}\sqrt{g}\frac{[\alpha(1+s\alpha)]^{3/2}}{(1+2s\alpha)^{1/2}} \text{ or}$$

$$\frac{Q_c}{b^{5/2}}\frac{1}{\sqrt{g}} = \frac{[\alpha(1+s\alpha)]^{3/2}}{(1+2s\alpha)^{1/2}} \quad . . . . . (4)$$

which is a dimensionless expression for Q_c. However, to facilitate practical applications, Eq. 4 will be computed in the form

$$\frac{Q_c}{b^{5/2}} = \frac{\sqrt{g}[\alpha(1+s\alpha)]^{3/2}}{(1+2s\alpha)^{1/2}} \quad . . . (5)$$

The curves for $\frac{Q_c}{b^{5/2}}$, shown in Fig. 3, use $g = 32.2$ ft/sec², and are applicable therefore only in the foot-pound-second system of units.

Example 2: Determine the critical depth for the channel section of Fig. 5 (b) for a discharge of 10,000 cfs.

$$Q_c/b^{5/2} = 10{,}000/100^{5/2} = 0.100$$

From Fig. 3, $y_c/b = 0.0645$. Then $y_c = 0.0645 \times 100 = 6.45$ ft.

[3] Op. cit., p. 35.

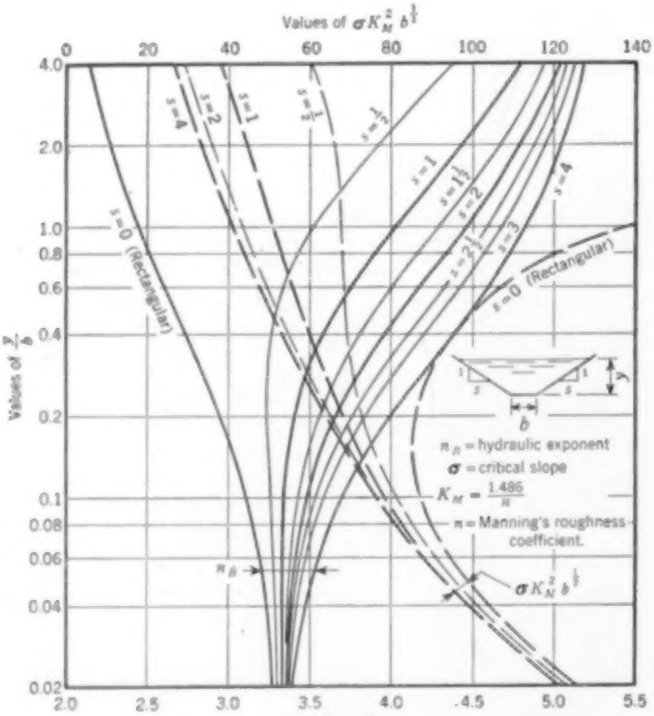


FIG. 4. CURVES FOR n_B, computed by Eq. 12, give hydraulic exponent and critical slope in rectangular and trapezoidal channels

TABLE II. COMPUTATIONS FOR EXAMPLE 4 ON VARIED FLOW PROFILES (SEE FIG. 5)

(1) Reach	Sta. 0 + 00 to Sta. 25 + 00	Sta. 25 + 00 to Sta. 50 + 00
(2) y_2	6.45	11.5
(3) $\alpha_2 = y_2/b$	0.0645	0.115
(4) $\sigma K_M^2 b^{1/3}$	80	73
(5) $\sigma = (4)/K_M^2 b^{1/3}$	0.0071	0.0066
(6) $\beta = S_0/\sigma$	0.07	0.08
(7) $1 - \beta$	0.93	0.92
(8) $\eta_2 = y^2/y_0$	0.457	0.817
(9) n_B*	3.5	3.5
(10) $B(\eta_2)$†	0.464	0.946
(11) $(1-\beta)B_2 = (7) \times (10)$	0.431	0.871
(12) $\pi_2 = (8) - (11)$	0.026	−0.054
(13) L	2,500	2,500
(14) LS_0/y_0	0.089	0.089
(15) $\pi_1 = (12) - (14)$	−0.063	−0.143
(16) η_1‡	0.817	0.892
(17) $y_1 = \eta_1 y_0$	11.5	12.5
(18) $\alpha_1 = y_1/b$	0.115	0.125

* Enter Fig. 4 with average value of α_2 and α_1.
† From Professor Bakhmeteff's Varied Flow Function Tables (*Hydraulics of Open Channels*, pp. 308–311).
‡ From Varied Flow Function Tables. See also *Hydraulics of Open Channels*, p. 95, Question 2.

3. **Critical Slope.** An expression for the critical slope[3] is

$$\sigma = \frac{Q_c^2}{K^2}.$$

Substituting the value of K from Eq. 2, $\sigma = \dfrac{Q_c^2}{K_M^2(AR^{2/3})^2}$ or

$$\sigma K_M^2 = \frac{Q_c^2}{(AR^{2/3})^2} \quad . \quad . \quad . \quad . \quad (6)$$

Values of Q_c and $AR^{2/3}$ are given by Eqs. 4 and 3, respectively. Substituting in Eq. 6,

$$\frac{\sigma K_M^2 b^{1/3}}{g} = \frac{1}{1 + 2s\alpha} \frac{(1 + 2s'\alpha)^{4/3}}{[\alpha(1 + s\alpha)]^{1/3}} \quad . \quad (7)$$

which is a dimensionless expression for the critical slope. As in the case of the critical discharge, Eq. 7 will be written as follows to facilitate application:

$$\sigma K_M^2 b^{1/3} = \frac{g}{1 + 2s\alpha} \frac{(1 + 2s'\alpha)^{4/3}}{[\alpha(1 + s\alpha)]^{1/3}} \quad . \quad (8)$$

Curves for $\sigma K_M^2 b^{1/3}$ are given in Fig. 4.

Example 3: Determine the critical slope corresponding to the critical depth (6.45 ft) computed in Example 2.

$y/b = 6.45/100 = 0.0645$. From Fig. 4, $\sigma K_M^2 b^{1/3} = 86$. Then $\sigma = 86/(49.5^2 \times 100^{1/3}) = 0.00757$.

4. **The Hydraulic Exponent.** Bakhmeteff defines the hydraulic exponent, n_B, as twice the rate of change of log K with respect to log y as determined by logarithmic plotting.[4] Let $\log y = F$; then the hydraulic exponent, n_B, can be expressed analytically as

$$n_B = 2\,\frac{d(\log K)}{dF} \quad . \quad . \quad . \quad . \quad . \quad (9)$$

By Eq. 2, $K = K_M AR^{2/3}$; $\log K = \log K_M + \log (AR^{2/3})$, and

$$\frac{d(\log K)}{dF} = \frac{d[\log (AR^{2/3})]}{dF} \quad . \quad . \quad (10)$$

From Eq. 3,

$$\log (AR^{2/3}) = \log b^{8/3} + \frac{5}{3}\log (\alpha + s\alpha^2) - \frac{2}{3}\log (1 + 2s'\alpha) \,. \quad (11)$$

[3] Op. cit., p. 47.
[4] Op. cit., p. 84.

As defined above, $\log y = F$. Then $y = e^F$, $\alpha b = y = e^F$, $\alpha = \dfrac{e^F}{b}$, and $\dfrac{d\alpha}{dF} = \dfrac{e^F}{b} = \alpha$.

Differentiating Eq. 11 with respect to F, and substituting the result in Eq. 9 gives:

$$n_B = \frac{10}{3}\,\frac{1 + 2s\alpha}{1 + s\alpha} - \frac{8}{3}\,\frac{s'\alpha}{1 + 2s'\alpha} \quad . \quad (12)$$

which is a dimensionless expression for n_B.

Eq. 12 in another form is

$$n_B = \frac{10}{3}\,\frac{\left(\dfrac{1}{\alpha} + 2s\right)}{\left(\dfrac{1}{\alpha} + s\right)} - \frac{8s'}{3\left(\dfrac{1}{\alpha} + 2s'\right)} \quad . \quad (13)$$

For the limiting case of a triangular section $1/\alpha = 0$, and $n_B = \dfrac{20}{3} - \dfrac{8}{6} = 5.33$, which agrees with the value given by Bakhmeteff for this case[5] with $p = 1/6$ in the expression $C = \dfrac{1.486R^p}{n}$. (If the Manning formula is used, $p = 1/6$.)

For the limiting case of a very deep rectangular section, $1/\alpha = 0$, $s = 0$, and $s' = 1$. Substituting in Eq. 13, $n_B = \dfrac{10}{3} - \dfrac{8}{6} = 2$, which is the value given by Bakhmeteff for this case.

For the limiting case of a very wide rectangular section, $\alpha = 0$, $s = 0$, and $s' = 1$. Substituting in Eq. 12, $n_B = \dfrac{10}{3} = 3.33$, which agrees with Bakhmeteff's value for $p = 1/6$.

Curves for n_B, computed by Eq. 12, are shown in Fig. 4.

Application to Computation of Varied Flow Profiles

Example 4: Use of the curves in the computation of varied-flow surface profiles will be explained by the following example.

A canal having the profile and cross section shown in Fig. 5 terminates in a free fall. Find the depths of flow at Stations 0 + 00, 25 + 00 and 50 + 00, with n = 0.030, and a discharge of 10,000 cfs.

Solution: Flow at the fall will be at critical depth, determined in Example 2 to be 6.45 ft. The uniform flow depth, y_0, is 14.1 ft as computed in Example 1.

[5] Op. cit., p. 86.

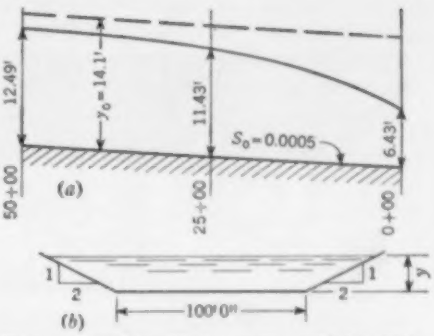


FIG. 5. PROFILE (*a*) AND CROSS SECTION (*b*) of trapezoidal channel illustrate solution of numerical examples.

To find the depths at Stations 25 + 00 and 50 + 00, Bakhmeteff's Varied Flow Function Tables and the curves of Fig. 4 will be used. The computations are set up in Table II. The nomenclature for terms not already defined herein is the same as that used by Bakhmeteff except that the hydraulic exponent is designated n_B instead of n.

It is noted that in determining terms (4) and (9) in Table I a value of α equal to the average of α_1 and α_2 should be used. However, a large error in α_1 will ordinarily have only a small effect on σ and an even smaller effect on the value of $1 - \beta$. As the value of n_B need be determined only to the nearest tenth, here too an error in the assumed value of α_1 will have a negligible effect on the result.

Acknowledgments

The author is thankful for valuable suggestions by Professor Bakhmeteff. The assistance of Louis Katona, Jr., and Norris Matthews, both Juniors ASCE, in preparing the curves in Figs. 2, 3, and 4, is gratefully acknowledged.

Full-size prints of Figs. 2, 3, and 4 are available at cost (40 cents for the set) from the author at Knappen Tippetts Abbett Engineering Co., 280 Madison Avenue, New York 16, N.Y.

Suspension Bridge Supports 1,500-Ft Belt Conveyor on 19-Deg Incline

INCLINED SUSPENSION BRIDGE constructed of wire rope and light steel sections supports belt conveyor system for new cleaning plant of United States Coal & Coke Co., subsidiary of U.S. Steel Corp., in Gary, W.Va. Catenary sway braces attached to outriggers at main supporting towers stabilize bridge against side sway in high winds. Belt—built by Goodyear Tire & Rubber Co., Akron, Ohio—can transport shale, rock, slate, and other coal-cleaning spoil, discharging 350 tons hourly 486 ft above loading point. Built in three sections and vulcanized on job, belt makes 3,000-ft round trip at 400 fpm. Belt system is weather-protected by corrugated metal hood.

... THE READERS *Write*

Test Data on Use of Super-Compactor Summarized

Editor's Note: Since many inquiries have reached "Civil Engineering" regarding results obtained through use of the super-compactor, described in the March 1948 issue (page 19), the following summary of test data on its use, prepared by O. J. Porter, M. ASCE, designer of the super-compactor, is presented here.

To the Editor: While the results obtained with the super-compactor will vary depending on soil conditions, I think I can best answer questions submitted to me by furnishing a summary of test data on the Baltimore Friendship Airport project, referred to in the March issue.

The soil on this project consists of nonplastic sandy material, containing from 5 to 25 percent of particles passing the 200-mesh sieve. The cuts on this project were compacted by making eight passes with the super-compactor loaded to 150 tons. Densities ranging from 100 to 109 percent were obtained on test areas to depths of 5 ft. The over-all testing program on the project has included a large number of test pits to a depth of 5 ft. Henry B. McDonald, construction engineer for the Whitman, Requardt-Greiner Co. who represent the city of Baltimore on the project, furnished me the following summary of the tests.

High compaction was obtained to a depth of from 4 to 5 ft, with 50 percent of the tests on the sandier portion of the material showing densities of 105 percent or more of the Modified AASHO Standard. Densities in excess of 100 percent of the same Modified Standard were shown in 80 percent of all tests. Only 20 percent of the tests showed densities slightly less but approaching 100 percent, and most of these tests were on the finer material, containing up to 25 percent of particles passing a 200-mesh sieve.

Most of the cuts and fills on the initial program had been constructed to approximate grade prior to putting the super-compactor into use. The fills, which previously had been compacted in 6- to 8-in. layers with a heavy standard sheepsfoot roller (550 psi), generally settled from 2 to 4 in. under eight passes of the super-compactor, but numerous loose and weak areas were encountered on the runways where the settlement ranged up to 12 in. These exceptionally weak areas undoubtedly could not have been detected without using the super-compactor, which in effect pretested every square yard of subgrade prior to placing the pavement.

The cuts usually settled from 2 to 12 in. under eight passes of the super-compactor and developed a considerable number of unstable areas where clay lenses were present within 3 or 4 ft of the subgrade. These areas, many of which were only 8 to 20 ft in diameter, were well outlined after four passes of the roller as the underlying weak clay caused heaving and weaving under the roller. After four passes of the roller, the inferior material was removed with scrapers and deposited on field areas beyond the shoulders. Then selected material was brought in from cut areas to bring the entire subgrade area up to grade. Four additional passes of the super-compactor were then made, lapping the roller about 80 percent to compact the subgrade prior to placing the 7-in. bituminous stabilized sand base course which was also selected from cut areas on the project.

Well-graded commercial aggregate is being imported for the top 3 in. of t pavement, which consists of asphal concrete placed in two courses. T tests at Baltimore conclusively prov that high densities of 100 percent or mo can be obtained to a depth of 4 or 5 with the super-compactor, if the mater consists of granular soil of a pervi nature. The rolling was carried out a speed of about $1^1/_2$ mph. A slow speed of course desirable, as it allows suffici time for the air to escape.

The 200-ton roller can be operat empty or partially ballasted with loads 50 to 150 tons when compacting clays other weak soils, the load being progre sively increased as the strength of the su grade is increased by compaction and t placement of successive layers of select material. The rollers are designed for large variation in weight in order to stre the soils to their maximun strength without causing shear failure. The 80 a 100-ton highway models of the super-co pactor can be utilized with any lo from 15 tons to their maximum ballast capacity. They are both about $9^1/_2$ wide and 16 ft long without the tong and can be readily handled by tract equipment available on most highwa projects. I feel sure that these small units will do much to stabilize the su grades on highways and to elimina many of the weaknesses that have d veloped under heavy traffic during t past few years, thus resulting in su stantial savings in construction costs.

O. J. Porter, M. ASC
Consulting Engin

Sacramento, Calif.

Canal Lining on Columbia Basin Project Described

To the Editor: In connection with Mr. Downs' paper in the August issue, describing many of the construction problems involved in the Columbia Basin Project, I should like to discuss canal-lining problems encountered.

All irrigation water delivered to Columbia Basin lands has to be pumped an average of 280 ft, and since a large part of the Basin land is underlain by porous sand and gravel it is necessary to line a large part of the canal system to reduce losses and thus conserve power. Other locations may require that the canal be lined to insure safety. An adequate but inexpensive lining has not yet been developed. However, considerable effort is being made to develop such a lining, as there will be hundreds of miles of lined canals on the project and present methods are costly. In particular, th Bureau of Reclamation is conductin wide-range tests for the purpose. O the Pasco lateral system, experimenta sections of lining have been placed, usin 2- and 3-in. unreinforced concrete, 2-in asphalt, $1^1/_2$- and 2-in. pneumatically ap plied mortar or Gunite, and asphalti prime membrane linings. Elsewhere i the Northwest, soil-cement lining, precas blocks of asphalt and concrete, and othe experimental linings are being tested. Al

ugh some advances have been made, a isfactory solution to the problem is t yet in sight.

While the high cost of labor and materials makes the lining of small canals expensive, additional factors make the ing of large canals such as those found the Columbia Basin Project even more stly. These canals vary from the main al with a bottom width of 50 ft and op width of 120 ft to small laterals. e lining of such large canals requires e design and manufacture of special uipment for each section to be lined. e machines can be altered to fit similar s, but because of their size and weight ch movement and alterations are expensive. For example, the lining equipment for the West Canal cost an estimated $500,000. It weighs about 410 ns, and the freight charge for delivering was approximately $23,000. It is obvious that the job of moving this equipment only a few miles to another section canal is a major operation.

Since concrete lining represents a large rt of the cost of canal construction, ery effort is being made to reduce lining costs to a minimum. Steps that have been taken in that direction include:

1. Elimination of design and specification requirements, wherever possible without impairing the quality. Elimination of extensive finishing operations is an example.

2. Design of canals with a minimum number of section changes so as to reduce the cost of altering lining equipment.

3. Design of structures that normally intersect the canal prism, so far as practicable, to avoid interference with the lining equipment.

The Columbia Basin Project will require construction of about 400 miles of main canals and 4,000 miles of laterals, and a large part of these will be lined. Although the goal set for low-cost lining has not yet been reached, many problems have been solved by cooperation between the designers, the construction personnel, and the contractors.

A. J. DAVIDSON
Chief, Engineering Section, Irrigation Division, Columbia Basin Project
Ephrata, Wash.

New Citizen Treasures His Membership in ASCE

TO THE EDITOR: The recent editorial, "Why Join the ASCE?" in the July issue, prompts me to write this, with the thought that members may be interested in the views of one who, not too long ago, was behind the "Iron Curtain," but who now is expecting to be a citizen of the United States and is happy to be a member of the American Society of Civil Engineers.

I date the real beginning of my engineering career from the time I received my membership in the ASCE in May 1947. I am a member of another American technical organization, as well as two leading European engineering societies. However, in no society have I experienced such genuine friendship, fellowship, and personal attention as have been shown me by the ASCE. There is a wonderful spirit in the ASCE. Its aims as given in the Code of Ethics are to be kept and respected; they also serve the purpose of training junior engineers in the American professional way of life. I believe the aims are the equal of any contained in any code of ethics of any professional society the world over.

But, as I see it, the most important work of the ASCE is the hard work of promoting engineering knowledge, step by step, and year after year. The ASCE does not dwell on promises to members regarding professional help in the way of more money or of other privileges of professional engineering. But everyone in it feels the spirit of brotherhood and of mutual helpfulness.

Every time I speak with a man on whose lapel I see the badge of the ASCE, I feel first great respect for the knowledge and integrity for which he received membership in the Society, and then that I can discuss with him all my problems, troubles and plans and that he will listen and do his best for me. We realize at once that we are both members of one family, united by our faith in the strength and dignity of the Society and in the profession of civil engineering.

BOLESLAW A. HUPCZYC, M. ASCE
New York, N.Y.

Caution Is Advised in Use of Newton Method

TO THE EDITOR: The three discussions on the solution of a cubic equation by means other than Cardan's formula, presented by Messrs. William R. Davis, N. A. Carle and H. Herbert Howe in recent issues of CIVIL ENGINEERING are interesting. Mr. Howe is quite correct in advocating Newton's method as being the easiest in most cases, and particularly in stating that it is easier than either Mr. Davis' or Mr. Carle's method.

What Mr. Howe neglected to say, however, was that Newton's method must be used with discrimination. It occasionally happens that the second approximation is worse than the first, when a maximum, a minimum or a point of inflection on the curve occurs between the first approximation and the second. For instance, take the equation under consideration by the three discussers mentioned, $x^3 - 11.52x + 9.61 = 0$. As it is an equation of odd degree whose constant term is positive, it must have at least one negative root. If then -1 be taken as an approximation to that negative root, application of Newton's method yields $+1.36$ for the second approximation, which is clearly not what is desired, and eventually will yield the smaller of the two positive roots. The reason for this is the fact that the maximum point of the curve lies between the assumed and the real value.

Unless the characteristics of the equation are pretty well known beforehand, it is much better to avoid trouble by equating the first derivative to zero and solving it. This will give the abscissas of the maximum and minimum points. Equating the second derivative to zero will give the abscissa of the point of inflection. With the abscissas of these critical points known, an approximation can be made which will always give a closer approximation for the second value of x.

The great advantage of Newton's formula is that it can be applied to any type of equation, whether algebraic or transcendental, and that it may be applied to an algebraic equation of any degree. Its disadvantage is that it gives only real roots, not imaginary roots, but this is not usually a defect of great importance to the civil engineer.

FRANCIS E. PRAY, Assoc. M. ASCE
Knoxville, Tenn.

Calls Use of Typewriter Aid in Technical Writing

DEAR SIR: I want to express my appreciation of John A. Miller's article, "Technical Writing—an Easily Acquired Skill," in the May issue of CIVIL ENGINEERING. It encourages one to try his hand at technical writing. The article stresses John Dewey's principle—"We learn by doing."

I would like to add one idea to Mr. Miller's instructive article, which is that the beginner should learn to type. A typewriter is an effective tool for effective writing. With it, the writer will find that his ideas flow more freely and that he is able to think faster. He will have ten pencils working for him. A knowledge of typing also helps the writer summarize what he reads and interject his own comments on the reading matter.

MICHAEL YATSKO, Jun. ASCE
New York, N.Y.

SOCIETY NEWS

Nine Technical Divisions Schedule Sessions for ASCE Fall Meeting

Gathering, October 13–15, Helps Mark Boston Society of Civil Engineers Centennial

IN HOLDING ITS 1948 Fall Meeting in the historic city of Boston, the ASCE joins with the Boston Society of Civil Engineers—the oldest engineering society in the United States—in celebrating its 100th anniversary. An introduction to the city, cradle of American civilization, will be the theme of the general membership meeting on Wednesday morning, October 13, with addresses of welcome by Miles N. Clair, president of the Northeastern Section of the Society; Robert F. Bradford, Governor of Massachusetts; and James M. Curley, Mayor of Boston. ASCE President R. E. Dougherty will respond to these greetings, and talks on engineering education—by Leonard Carmichael, president of Tufts College, and George R. Harrison, dean of science at Massachusetts Institute of Technology—will complete the program.

Nine Technical Divisions to Meet

Ten sessions of nine ASCE Technical Divisions will comprise the technical program arranged for Wednesday and Thursday. A panel of city planning and engineer experts—headed by Admiral William H. Buracker, Boston Commissioner of Public Works—will discuss the Metropolitan Boston Master Plan for Highways (see August issue, page 75) before a joint session of the City Planning and Highway Divisions on Wednesday afternoon. Water supply and pollution problems in the New England area will be considered at a joint meeting of the Sanitary Engineering Division and the Boston Society of Civil Engineers, with Gordon M. Fair, member of the executive committee of the Division, presiding.

Other Divisions holding sessions at the Boston Meeting are the Construction, Power, Air Transport, Structural, and Surveying and Mapping Divisions. The Soil Mechanics and Foundations Division has scheduled two sessions, one of which will be devoted to the presentation of reports from the Second International Conference on Soil Mechanics and Foundation Engineering, held in Rotterdam in June. Participants in this program will be Karl Terzaghi, president of the conference; Frank A. Marston, chairman of the executive committee of the Division; Thomas A. Middlebrooks, and Willard J. Turnbull. Technical Division sessions will be reported in the November issue.

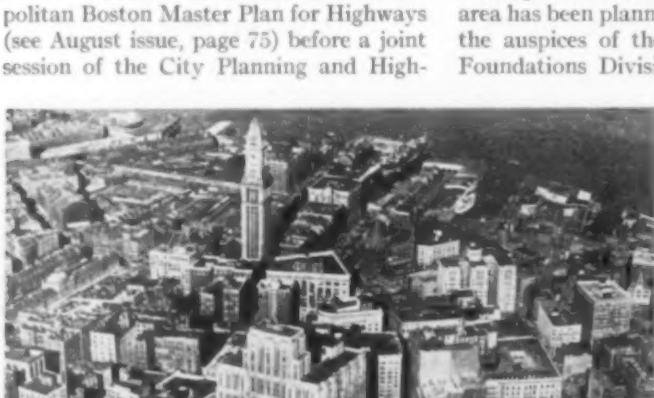
Excursions Arranged for Friday

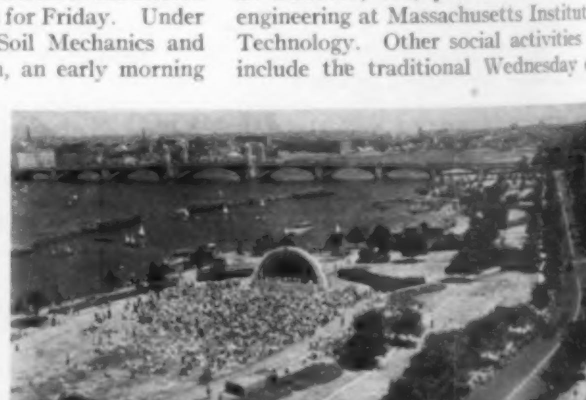
A variety of tours to points of engineering and historic interest in the Boston area has been planned for Friday. Under the auspices of the Soil Mechanics and Foundations Division, an early morning trip will be made to the Soil Mechanics Laboratories at Massachusetts Institute of Technology and Harvard University. The same group, in conjunction with the Air Transport Division, has arranged an afternoon tour of the Watertown Arsenal Soils Laboratory. A boat trip around Boston Harbor, to be sponsored by the Waterways Division, will afford an opportunity for inspection of waterfront installations.

Engineers not making these trips are offered a wide choice of excursions, ranging from the Boston Airport and Navy Drydock to the historic canals and locks in Lowell and the Lawrence Experiment Station. Late in the morning special buses will leave the Statler for a tour of points of engineering and scenic interest in the North Shore area, with a stop at the Gloucester Tavern for a New England shore dinner.

Joint Social Activities

Common origins of the Boston Society of Civil Engineers and the ASCE, which will celebrate its own centenary in 1952, will be traced at a joint luncheon of the two societies on Wednesday by John B. Babcock, 3rd, professor of railroad engineering at Massachusetts Institute of Technology. Other social activities will include the traditional Wednesday ev[ening]





AERIAL VIEW OF DOWNTOWN BOSTON (left) shows waterfront installations, objective of Fall Meeting inspection trip to be sponsored by ASCE Waterways Division. Recreational development of Charles River Esplanade is pictured at right.

ning dinner dance and a buffet and smoker on Thursday evening, to which the ladies are invited. The program for the occasion will consist of a talk by James J. Britt, radio sports announcer, who will present some of the highlights of his experiences in broadcasting.

Entertainment for the ladies will include a tour of the Fogg Museum and a tea on Wednesday, and an all-day excursion on Thursday to the historic scenes at Concord and Lexington. There will be a stop for luncheon at the Colonial Inn in Concord. The Women's Committee on Arrangements is headed by Mrs. Charles B. Breed as chairman, and Mrs. Harrison P. Eddy, Sr., and Mrs. F. E. Winsor as honorary chairmen.

Student Chapter Conference Tuesday

Under the sponsorship of the Northeastern Section of the Society, a conference of Student Chapter delegates from engineering schools in the New England area will be held on Tuesday, October 12. An opportunity for students to meet members of the Board of Direction, which will be in session on Monday and Tuesday, will be provided at a joint luncheon under the auspices of the Northeastern Section. Emil A. Gramstorff is chairman of the Student Participation Committee.

ASCE Committee on Hydraulic Research Outlines Program of Investigation

To develop fundamental research in civil engineering on the widest possible basis, the Board of Direction of the Society has established a Committee on Research. In furtherance of the Society's aims and in anticipation of the establishment of a National Science Foundation (on which congressional legislation is pending), the Research Committee has requested the various Divisions of the Society to formulate plans for possible research in their particular fields. In this connection the Committee on Hydraulic Research of the Hydraulics Division has prepared a list of fundamental and special research projects in hydraulics to the end that a coordinated, well-rounded program of hydraulic investigation may be carried out in this country. A statement of the committee and list of research projects follow.

THE COMMITTEE ON Hydraulic Research is seeking the cooperation of every hydraulic laboratory and research agency for further improvement of the accompanying proposed list of projects and especially for initiating and organizing research. Indeed, it is the hope and the desire of the Committee on Hydraulic Research to have a representative from each agency to act as a contact member of the committee in order to expedite and facilitate the exchange of information and views and help in organizing and carrying out research work. Suggestions and additions for other research are most welcome, as the list is not considered complete. The committee would also appreciate being informed regarding facilities and personnel available to conduct research programs on any of the items mentioned in the list or on related subjects, and further regarding what use could be made of the existing facilities, if suitable personnel were provided.

The accompanying list of research problems is divided into two broad sections. The first lists a number of basic or fundamental subjects, each of which covers a wide field requiring years of systematic activities, with the work necessarily distributed between different laboratories. The vastness and the complexity of the problem suggest that the research be comprehensively planned and organized by directing bodies in the form of special subcommittees. In fact, the subjects listed under I/B and I/D have been already assigned to a Subcommittee on Cavitation and Subcommittee on Density Currents.

The second section covers "special or single projects." The subjects classified under this heading are in many ways equally important. They constitute, however, tasks of smaller and more restricted nature requiring less special instrumentation and organized planning. Some of these topics may serve as useful themes for Ph.D. theses or as individual undertakings. Successful research on some of these special problems will materially contribute to progress on the basic projects. In other instances, the special projects are quite independent and their solution will furnish information of general interest. Work on all of these projects is urgently needed.

It is important to realize that present-day requirements in hydraulic research differ essentially from observational work which in the past served to build up the traditional tests. Indeed, such past observations were mostly directed towards obtaining over-all empirical coefficients while modern design and maintenance demand comprehensive and detailed grasp of the behavior of water as it flows through structures in natural water courses and underground. It is necessary first to obtain a clear understanding of the physical features of the phenomena and only after this first step is mastered should one obtain quantitive interrelations. Hasty attempts to establish "working

Three Generations of Family in ASCE

FOR FIRST TIME of record in its history, ASCE simultaneously has three generations of one family enrolled as members. Shown is Saville family whose membership ranges from Junior to Life Member. Left to right: Dean Thorndike Saville of New York University, M. ASCE, past Director; Thorndike, Jr., Jun. ASCE, now doing graduate work in University of California; and Life Member Caleb M. Saville, manager and chief engineer, Hartford, Conn., Water Bureau, past-president of New England Waterworks Association, and 1914 winner of Norman Medal, highest ASCE award.

formula" at a stage when the essence of a phenomena is not as yet understood should be discouraged. Numerical interrelation should be sought only after the basic relations between the shaping factors are reliably established.

A major purpose of the Society's Committee on Research is to endeavor to obtain funds from various endowments and foundations for the purpose of financing fundamental research projects. If the legislation concerning the National Science Foundation becomes law, it is hoped that funds may be secured from that source. Under all circumstances no time should be lost in preparing and starting research plans. While obviously no guarantees can be given in advance, the committee stands ready to lend every possible assistance for obtaining funds required for promoting active research. Naturally, the prospect of obtaining support depends primarily on the nature and the "quality" of the project and on the care exercised in formulating aims and procedures for the proposed investigations.

The Committee on Hydraulic Research wishes to make it clear that its principal objective is to stimulate research activities along lines that will be productive and, if possible, to coordinate research so as to avoid unnecessary duplication. Suggestions and active correspondence on the part of the laboratories and research agencies are urgently solicited.

COMMITTEE ON HYDRAULIC RESEARCH
Boris A. Bakhmeteff, *Chairman*
G. H. Hickox, *Secretary*
Jacob E. Warnock
J. B. Tiffany, Jr.

LIST OF SUGGESTED PROBLEMS FOR HYDRAULIC RESEARCH

I. Basic or Fundamental Projects

- A. Turbulence
  - The physics and dynamics of turbulent phenomena.
  - The engendering, spreading, and dissipation of turbulence in the generic cases of:
    - 1. Established uniform patterns
    - 2. Boundary layers
    - 3. Separation sheets
  - Manifestations of the effects of turbulence:
    - 4. Suspension and movement of sediment
    - 5. Insufflation in high velocity flow
- B. Cavitation (Assigned to Subcommittee on Cavitation in Hydraulic Structures)
  - 1. Thermodynamics of cavity collapse
  - 2. Pressure developed at collapse
  - 3. Proximity of collapse to pitted surface
  - 4. Vortices producing cavitation
  - 5. Cavitation at pressures above vapor pressure
  - 6. Effects of aeration
- C. Movement of Sediment and Bed Load
  - 1. Movement of sediment in suspension
  - 2. Movement of bed load
- D. Density Currents (Assigned to Subcommittee on Density Currents)
- E. Oscillatory Waves
  - 1. Generation of waves by wind
  - 2. Refraction
    - *a.* Breakwaters (complete and discontinuous)
    - *b.* Islands
    - *c.* Headlands
    - *d.* Bays
    - *e.* Submarine valleys
  - 3. Diffraction
    - *a.* Breakwaters
    - *b.* Islands
    - *c.* Headlands
  - 4. Reflection
    - *a.* Breakwaters
    - *b.* Steep beaches
  - 5. Transformation of waves in shallow water
    - *a.* Orbital motion
    - *b.* Bottom discontinuities
    - *c.* Breaker characteristics
  - 6. Wave pressures
    - *a.* Breakwaters, jetties, sea walls, etc. (permeable and impermeable faces)

II. Special or Single Projects

- A. Hydraulic Friction in Steady Uniform Flow
  - 1. Pipes
    - *a.* Smooth surface patterns
    - *b.* Rough surface patterns
    - *c.* Intermediate patterns
    - *d.* Entrance transition patterns
    - *e.* Two-component flow (air and water)
    - *f.* Two-component flow (water and solids)
  - 2. Open Channels
    - *a.* Two-dimensional open surface patterns
    - *b.* Three-dimensional open surface patterns (secondary cross currents, spiral motion, position of maximum velocity)
    - *c.* Velocity patterns and resistance in supercritical flow
- B. Non-uniform Flow in Open Channel
  - 1. Velocity and friction patterns in varied flow
  - 2. Comparison of energy losses with uniform flow
  - 3. Recovery of kinetic energy in rapid flow patterns
- C. Boundary Layers in Hydraulic Structures
- D. Intake Phenomena
- E. Pulsation in Channels and Rivers
- F. Curvilinear Motion
  - 1. Bends and knees
  - 2. Expansions
  - 3. Laterals
  - 4. Modifying effects of friction
  - 5. "Cascade" or "interference" effects of successive changes in shape
- H. "Contraction" Phenomena
  - 1. Entrance to pressure conduits
  - 2. Entrance to open channels
  - 3. Piers
- I. Tailwater Phenomena
- J. Waterhammer
- K. Flow Through Granular Media
  - 1. Permeability coefficient, effects of shape and porosity
  - 2. Basic flow patterns
  - 3. Unsteady flow
  - 4. Quicksand conditions
- L. Unsteady Flow in Open Channels
  - 1. Flood waves
  - 2. Surges in service canals
  - 3. Tidal effects
- M. Model Tests
  - 1. Scale effects
    - *a.* On discharge coefficients
    - *b.* On erodible materials
    - *c.* On tidal reproductions
    - *d.* On eddy viscosity
  - 2. Effect of model distortion
    - *a.* On erosion
    - *b.* On velocity distribution
- N. Agreement of Model and Prototype
  - 1. Discharge coefficients
  - 2. Stilling basins
  - 3. Erosion tests
  - 4. Flood models
  - 5. Miscellaneous structures (lock, surge tanks, etc.)
- O. Instrumentation for Hydraulic Measurements
  - 1. Rapid pressure fluctuations
  - 2. Rapid velocity fluctuations
  - 3. Rapid changes in flow direction
  - 4. High velocities (30 to 200 ft per sec)
  - 5. Low velocities (down to 0.01 ft per sec)
  - 6. Direction of flow at depths up to 500 ft
  - 7. "Spot" velocities in the interior of a fluid
  - 8. "Spot" pressures in the interior of a fluid
  - 9. Dynamic response of instruments and connections
- P. Wave Action and Beach Erosion
  - 1. Littoral sand movement (effect of height, length, and direction of waves, and beach material)
  - 2. Equilibrium slope of beaches
    - *a.* With tide
    - *b.* Without tide
  - 3. Shore forms
    - *a.* Bays
    - *b.* Behind breakwaters
    - *c.* Hooked bays
    - *d.* Equilibrium shoreline of a jetty as a function of sand transportation
  - 4. Shore protection structures
    - *a.* Groins
    - *b.* Jetties
    - *c.* Bulkheads

Daniel W. Mead Prize Competition Announced

AT THE SEATTLE meeting of the ASCE Board of Direction, the Committee on Professional Conduct announced a new competition for the Daniel W. Mead Prizes for Junior and Student Chapter members, which were established and endowed in 1939 by ASCE Past-President and Honorary Member Daniel W. Mead. This year the subject is: "Under what conditions, and to what extent, is it ethical for an engineering society, such as a Local Section of the ASCE, to make studies and recommendations, without remuneration, on proposed public projects?"

All papers for entry in the competition must be in the hands of the Executive Secretary of the Society by June 1, 1949. Copies of the revised rules for contestants may be obtained from Society Headquarters, 33 West 39th Street, New York 18, N.Y.

Concrete Council Formed by Engineering Foundation

CREATION OF A council to conduct studies and experimental research in reinforced concrete and to interpret the results in the form of a code for the design of concrete structures, has been announced by the Engineering Foundation. Two investigations have been recommended by the ASCE Committee on Masonry and Reinforced Concrete for immediate consideration by the Council.

The purpose of the first of these investigations, to be carried on at Ohio State University, is to determine the shape of the stress block in reinforced concrete in the compression zone by means of photoelastic methods. This proposed study is a continuation of pilot tests already made at the university. The second investigation, to be conducted at the University of Illinois, will be concerned with reinforced concrete members subject to combined bending and direct stress. Tests will be conducted on 126 eccentrically loaded specimens with varying eccentricity ratios, varying percentages of steel, and for three different strengths of concrete.

Members of the new Council on Research in Reinforced Concrete are Robert Blanks, M. ASCE, director of research, U.S. Bureau of Reclamation, chairman; Prof. Jewell M. Garrelts, Columbia University, secretary; Prof. Clyde T. Morris, M. ASCE, Ohio State University; Prof. Frank E. Richart, M. ASCE, University of Illinois; F. R. Smith, chairman of the Committee on Masonry, American Rail-

way Engineering Association; Raymond Archibald, chairman, Bridge Specification Committee, American Association of State Highway Officials; Albert E. Cummings, M. ASCE, research engineer, Raymond Concrete Pile Co.; Arthur J. Boase, M. ASCE, Portland Cement Association; and Harold D. Jolly, chairman, Engineering Practice Committee, Reinforcing Steel Institute.

Richard J. Murphy Joins Advertising Staff of C. E.

RICHARD J. MURPHY, of Richmond Hill, N.Y., has joined the advertising sales staff of CIVIL ENGINEERING. Formerly on the advertising sales force of the industrial division of Phil Broderick Associates, New York City publishers' representatives, and with Hoffman-Harris, Inc., of New York, Mr. Murphy has had wide experience in the field of industrial and trade publications.

Committee on Salaries Publishes Final Report

FINDINGS OF THE ASCE Committee on Salaries on the 1947 salaries of teaching positions in the civil engineering field are summarized in the final report of the committee. In making its survey, the committee was faced with two problems: (1) To decide where teachers of engineering should appear in published salary scales, and (2) to develop an objective method which can be used by deans or other administrative officers in fixing salaries of teaching positions. Brief progress reports on the survey, based on circulation and analysis of a questionnaire, appeared in the September 1947 issue (page 50) and the February 1948 issue (page 56).

Copies of the final report have been made available to deans of engineering schools. Additional copies may be obtained from Society Headquarters, 33 West 39th Street, New York 18, N.Y.

Engineering Education Reports Are Available

A REPRINT OF the progress reports of the Society's Committee on Engineering Education for 1944 and 1945, published as a single 20-page pamphlet, is available in limited quantity. Published originally in the March 1946 issue of PROCEEDINGS, the reports have been out of print for some time. Joint publication of the reports was authorized by the Board of Direction at its January 1946 meeting.

Inquiries should be addressed to Society Headquarters, 33 West 39th Street, New York 18, N.Y.

GROUP AT HEAD TABLE AT SNOQUALMIE FALLS PRE-CONVENTION DINNER, sponsored by Seattle Section, includes Society officers and their wives. Left to right, around table, are Mrs. John Cunningham; ASCE President R. E. Dougherty; Past-President J. C. Stevens; Thomas H. Campbell, secretary, Seattle Section; Fred C. Scobey; ASCE Past-President W. W. Horner; Mrs. Fred Scobey; R. O. Sylvester; Mrs. W. W. Horner; ASCE Director Julian Hinds (only partly visible); Mrs. B. P. Thomas; ASCE Vice-President John W. Cunningham (only partly visible); B. P. Thomas, president, Seattle Section; and Mrs. J. C. Stevens.

ATTENDING PRE-CONVENTION DINNER are, left to right, L. Austin Wright, secretary, Engineering Institute of Canada; ASCE President R. E. Dougherty; John Finlayson, president, Engineering Institute of Canada; and B. P. Thomas, president of Seattle Section. Dinner was sponsored by Seattle Section.

Role of EJC in Fostering Professional Understanding Reported

ACHIEVEMENTS OF ENGINEERS Joint Council in presenting the American point of view to foreign engineers and others and in removing barriers to professional and social understanding everywhere are reported in recent EJC releases.

Among the international activities cited in the report are cooperation with the Committee on International Relations, which is completing a survey of educational and professional facilities in South America for the State Department; participation in the World Engineering Congress in Paris; encouragement of the development of a Pan-American Engineering Union; representation at the forthcoming London Conference of Engineers; and active cooperation in UNESCO educational programs.

The report states that 7,000 active practicing engineers, of the 100,000 members in the constituent societies represented by EJC, are working abroad in 80 countries, speaking the universal language of technology and gaining a thorough understanding of foreign engineers and their problems. The societies represented in EJC have nearly 400 committees, 172 of which are cooperating with allied engineering groups. In cooperation with various foreign societies, EJC has sponsored the award of full scholarships to foreign students in American universities.

Through the efforts of EJC, more than 70,000 volumes of technical literature have been donated to libraries and colleges in devastated areas, and the various constituent societies have 91 centers in foreign countries for the free distribution of their periodicals and literature. Evidence of reciprocal interest in American technical and professional activities is the fact that in 1947 the various societies received 7,000 foreign subscriptions to their engineering periodicals.

Mid-South Section Plans Two-Day Fall Meeting

As part of the centennial celebration of the University of Mississippi, the Mid-South Section is holding its two-day fall meeting on the university campus, October 8 and 9.

Utilization of engineering in construction will be the theme of the meeting, which will feature panel discussions by well-known engineers and contractors and an exhibition of new construction equipment and machinery.

Scheduled speakers include B. J. Fry, M. ASCE, vice-president of the E. J. Albrecht Co., Chicago; Nello L. Teer, Jr., of the Nello Teer Co., Durham, N.C.; James T. Denton, general superintendent of Merritt-Chapman Scott, New York; and E. E. White, M. ASCE, assistant vice-president, Spencer, White & Prentis, New York. The annual banquet address will be delivered by Dwight W. Winkelman, Syracuse, N.Y., president of the Associated General Contractors of America.

NEWS OF LOCAL SECTIONS

Scheduled ASCE Meetings

FALL MEETING
Boston, Mass., October 13–15
(Board of Direction meets October 11–12)

ANNUAL MEETING
New York, N.Y., January 19–21
(Board of Direction meets January 17–18)

SPRING MEETING
Oklahoma City, Okla., April 20–23
(Board of Direction meets April 18–19)

Coming Events

Cleveland—Dinner at the Cleveland Engineering Society, Cleveland, October 15, at 6:30 p.m., meeting at 8 p.m.

Connecticut—Meeting at the Hotel Bond, Hartford, October 6, at 6:30 p.m.

Florida—Meeting at the Seminole Hotel, Jacksonville, October 14, at 7 p.m.

Illinois—Meeting at the Auditorium, 20 North Wacker Drive, Chicago, October 4, at 7:30 p.m.

Metropolitan—Meeting at the Engineering Societies Building, New York, October 20, at 8 p.m. Dinner meeting of the Junior Branch at the Hotel Diplomat, October 6, at 6:30 p.m. President R. E. Dougherty will speak on "Our ASCE and Some General Problems for the Engineer.

Northwestern—Meeting at the Coffman Memorial Union, University of Minnesota, Minneapolis, October 4, at 6:30 p.m.

Pittsburgh—Joint meeting with Civil Section of Engineers Society of Western Pennsylvania, William Penn Hotel, Pittsburgh, October 1, at 8 p.m.

Sacramento—Regular meetings every Tuesday at the Elks Temple, Sacramento.

San Francisco—Dinner meeting sponsored by the Sanitary Committee, Engineers' Club, October 19, at 6 p.m. Dr. Paul L. Magill, of the Stanford Research Institute, will speak on "Some Engineering Aspects of the Los Angeles Smog Problem."

Texas—Fall meeting in Tyler, on October 7, 8 and 9.

Wisconsin—Meeting in Madison, October 20.

Recent Activities

COLORADO

Public interest and support as important factors in improving sanitation were emphasized by Lewis A. Young, opening speaker in a symposium on "Progress in Sanitation in Colorado" that constituted the technical program at the September meeting. Mr. Young, who is director of the Sanitation Division of the Colorado Department of Public Health, described the state-wide program in sanitation that is being inaugurated by the State Board of Health. Carroll Coberly, Denver consultant, then spoke on stream sanitation, describing the many conditions that result in pollution. In particular, he warned of the danger of contamination from underground flow, resulting from increased use of septic tanks, improper construction of wells, and other unsanitary practices. Participants in a general discussion on sanitary engineering that concluded the program included C. T. Carnahan, of the U.S. Public Health Service; James A. King and Willis T. Moran, of the State Health Department; and W. E. Blomgren, of the U.S. Bureau of Reclamation. F. E. Schmitt, assistant to the chief engineer of the Bureau of Reclamation, was in charge of the program.

FLORIDA

Wartime tests made on the American version of the Bailey Bridge were described at the first meeting of the fall season by Prof. D. Allan Firmage, of the University of Florida, who was in charge of the tests for the U.S. Engineer Board. Proposed changes in the Section constitution, permitting establishment of Sub-Sections or a state-wide system of vice-presidents in order to make Section activities available to the entire Section membership, were discussed during the business meeting. The group was also asked to formulate an engineering itinerary for possible use by delegates from an engineering congress in Havana, Cuba, who will tour the state.

LOS ANGELES

Possible solutions to the mass transportation problem of the Los Angeles metropolitan area were presented to members of the Section at the September 8 dinner meeting by Henry A. Babcock, Los Angeles consultant and lecturer at the University of Southern California. Proposals advanced by Mr. Babcock included a coordinated subway-and-surface high-speed system. He illustrated his talk with slides and charts.

The Junior Forum, meeting prior to the regular program, had as its subject of discussion, "The Development of an In-Service Training Program." The principal speaker appearing on this program was Clarence J. Derrick, commissioner of the Los Angeles Board of Public Works, who has been directing the city's training program.

LOUISIANA

Construction costs in Alaska are from two and a half to five times higher than they are for similar work in the United States, Capt. W. B. Howard, public works officer and chief of construction for the 8th Naval District at New Orleans, told members of the Section at a recent meeting. Addressing a joint session with the Louisiana Engineering Society on construction problems encountered in Alaska by the Navy during the war, Captain Howard stated that construction must withstand winds with a velocity of 150 mph. To meet this problem Navy engineers usually built with concrete to the second floor, using Strans-steel with asbestos-covered siding walls anchored to the steel for additional stories. Exceptionally hard surfaces were required for airport runways to withstand the action of tire chains, and concrete and

steel had to be used for all waterfront construction because of teredo action. During the business session, the Section presented a prize of Junior membership in the Society to Robert F. Bland, recent civil engineering graduate from Tulane University.

METROPOLITAN

THE ANNUAL SUMMER meeting and picnic of the Junior Branch was held recently at the Westport, Conn., laboratories of the Dorr Co. An inspection trip was conducted through the laboratories, which are devoted to the study of sewage-treatment processes and equipment and mineral refining and processing equipment. Swimming, boating, and other sports and a picnic supper completed the outing. Elwyn King has submitted his resignation as president of the Junior Branch because of leaving the metropolitan area. He will be succeeded as president by S. Ralph Angell, previously secretary of the Branch, and the new secretary is Paul Oberleitner, former treasurer.

KANSAS CITY SECTION

ASCE PRESIDENT R. E. DOUGHERTY was guest of honor and principal speaker at a recent picnic dinner and meeting held at the J. C. Nichols farm, near Kansas City. The attendance of 179 included Robert B. Brooks, St. Louis consultant and member of the St. Louis Section, who described his experiences and engineering impressions gleaned on a recent trip to Europe. President Dougherty's talk centered about his experiences as a railroad man. Harold Brush was in charge of making preparations and arranging the program for the picnic, which included music and dancing for the young folks in attendance.

ST. LOUIS CONSULTANT ROBERT B. BROOKS (left) and ASCE President R. E. Dougherty are principal speakers at picnic dinner and meeting program, sponsored by Kansas City Section at farm of J. C. Nichols, Section member.

ONE OF TABLES AT RECENT KANSAS CITY SECTION PICNIC shows Robert B. Brooks, guest from St. Louis Section (left, foreground) and former Vice-President E. E. Howard, ASCE President Dougherty, and Mrs. E. E. Howard (facing camera, left to right, at right of table). Other picnickers are not identified.

PHILADELPHIA

IN A SUMMARY of its activities for its first year, the Junior Forum of the Philadelphia Section draws attention to its Speakers Bureau. Organized for the twofold purpose of affording Juniors opportunities to speak in public and of providing trained speakers for Student Chapter groups in the Section, the Bureau has functioned with marked success. In addition to furnishing the entire program for a monthly meeting of the Section, the Bureau has also supplied speakers for seven meetings at five different colleges during the past year. Robert Diskant directed the Bureau, with the assistance of Robert Lehman, A. Barton Lewis, and Charles E. Roller, Jr. The Forum has functioned under the chairmanship of Robert W. Richards, with Paul M. Edwards serving as vice-chairman and Joseph A. Wintz, Jr., as secretary.

PITTSBURGH

THE PITTSBURGH SECTION was joint sponsor—with Engineer Reserve units in the area and the Pittsburgh post of the Society of American Military Engineers—of a recent soil conference, conducted by Robert R. Philippe as part of the Second Army Training Program for Engineer Reserve Officers in the district. There were approximately 60 in attendance. Other recent Section activities include a family picnic in the recreation area at Crooked Creek Reservoir. Following inspection of the flood-control dam connected with the project, the group enjoyed swimming and badminton. Arrangements for the picnic were made by Ely G. Fenton, working with Wilfred Bauknight, chairman of the program committee.

SACRAMENTO

PUBLIC WORKS IN Afghanistan, India, and Egypt were discussed at a recent luncheon meeting by S. O. Harper, consulting engineer of Oakland, Calif., and chief engineer of the Bureau of Reclamation until his retirement in 1944. Mr. Harper visited the three countries in an official capacity, inspecting public works in Egypt and Afghanistan and the Bakra dam site in India. Other recent luncheon speakers include Verne Ketchum, chief engineer for Timber Structures, Inc., of Portland, Ore., who described modern timber design and construction; Gerald Fitzgerald, chief of the Topographic Branch of the U.S. Geological Survey, who outlined the history of the Survey; and Drury Butler, civil and mining engineer of Sacramento.

NEWS BRIEFS

Huge Expansion Program Planned by Metropolitan Water District of Southern California

To keep pace with constantly increasing demands for water in the metropolitan areas of Southern California, cities comprising the Metropolitan Water District have embarked on a $47,000,000 water-facilities program, according to a report by ASCE Director Julian Hinds, chief engineer and general manager of the District. This report is summarized in a recent issue of *Aqueduct News*. Pointing out that use of Colorado River water by District cities has increased 100 percent over 1947, the report states that an additional 513,500,000 gal of water storage, 168 miles of water mains, and several new pumping plants will supplement the distribution facilities in District areas.

"Almost every city in the District is rushing work on extensions and enlargements to its water systems," Mr. Hinds reports. Los Angeles heads the list, with a planned expenditure of $25,000,000, to be made by the Department of Water and Power.

The major feature of the Los Angeles program is the large earthfill dam being built at Baldwin Hills. This structure will create a 300,000,000-gal reservoir to help meet the unprecedented demands for water in the southwestern section of the city. Los Angeles will also augment its use of Colorado River water by construction of 10 miles of conduit, 66 in. in diameter, extending from Eagle Rock to Hollywood Reservoir. In addition, 80 miles of local water lines are to be installed.

More than $4,000,000 of the Water District's $7,000,000 budget is being spent on an addition to its softening and filtration plant, increasing its capacity by 100,000,000 gal.

Long Beach has developed a master expansion program for enlarging its water system over a period of years. Increased storage capacity and construction of 20 miles of pipeline are included in the plan, which is being financed by a $6,500,000 water bond issue. The cities of Burbank, Glendale, and San Diego are investing more than $2,000,000 each, and Compton, Glendale, and Pasadena report the need for new reservoirs at an early date, according to Mr. Hinds.

The Metropolitan Water District recently completed its seventh year as an operating utility. When the Colorado River Aqueduct started operation in 1941, thirteen cities comprised the District. This number has now increased to 26 incorporated cities and many coastal areas, serving a population of 3,425,000. The Colorado River Aqueduct system, originally planned as a supplemental supply for the area, is at present the only source of supply for Southern California. An article on the water plan of California by Edward Hyatt and a discussion by Samuel B. Morris appear on pages 18 and 23 of this issue.

New Construction Activity Reaches Record High

Nearly $1^3/_4$ billion worth of new construction, the highest monthly total on record, was put in place during July, according to joint estimates of the Departments of Commerce and Labor, released in a recent Industry Report of the Department of Commerce. This figure (estimated at $1,724 million) makes July the second successive month in which new construction activity surpassed all previously recorded dollar value peaks.

The July total, a 7 percent increase (slightly more than the normal seasonal rise) over the $1,605 million of new construction put in place during June, was more than one-third again as great as the total for July 1947. Figures for July bring the total value of new construction activity for the first seven months of 1948 to $9.4 billion—36 percent above the figure for the corresponding period of 1947.

Analysis of construction activity by geographical regions indicates that the Pacific Coast states moved into front-ranking position in dollar value of new construction work put in place during the first half of 1948 ($1,451 million, 19 percent of the national total $7,694 million). The North Central region (Illinois, Indiana, Michigan, Ohio, and Wisconsin) with $1,412 million, 18 percent of the national total, dropped back to second place regionally, followed by the Middle Atlantic States (New Jersey, New York, and Pennsylvania) with $1,205 million, 16 percent of the total.

Steadily rising construction costs must be regarded as an important factor in recent increases in the dollar value of new construction activity. These costs continued their steady month-to-month advance during June (the latest month for which cost data are available) according to the Department of Commerce Composite Index of Construction Costs. The June index level—with average costs during 1939 equal to 100—rose to 212.0, an increase of 1.3 percent over the May level and almost 13 percent above that of June 1947.

Purdue University Sponsors Industrial Waste Conference

Latest developments in the field of waste disposal and utilization were discussed at a recent two-day conference at Purdue University, sponsored jointly by the Indiana State Board of Health and the School of Civil Engineering and Engineering Mechanics at the university. In a general session initiating the conference, A. E. Gorman, M. ASCE, director, Water Division, Office of War Utilities, Washington, presented a paper on "Disposal of Wastes from Atomic Research," and Carl E. Schwob, M. ASCE, senior sanitary engineer for the Public Health Service, explained the new federal stream pollution control law.

Other ASCE members represented on the program included Don E. Bloodgood, associate professor of sanitary engineering at Purdue University, who appeared in a symposium on paper wastes; B. A. Poole, sanitary engineer for the Indiana State Board of Health, who spoke on "Accidents with Cyanide Plating Solutions" in a session on metal wastes; and A. H. Beard, Jr., of the University of Arizona engineering faculty, and Robert E. Stiemke, of Pennsylvania State College, who discussed meat packing wastes in a session on food processing.

W. Scott Johnson, Missouri state sanitary engineer, read a paper on "Aeration Plant for Milk Waste Disposal," in a symposium on dairy wastes, and W. E. Howland, professor of civil engineering at Purdue University, discussed problems arising in the disposal of oil wastes. Other ASCE speakers were W. D. Hatfield, superintendent of sewage treatment for Springfield, Ill., who described special laboratory tests for industrial wastes, and G. A. Rohlich, of the University of Wisconsin sanitary engineering staff, who addressed a general session on waste treatment.

Peacetime Record in Steel Production Is Established

Steel production in the first eight months of 1948 totaled more than 57,500,000 tons of ingots and steel for castings, the largest peacetime output for such a period on record, according to a recent announcement of the American Iron and Steel Institute. This figure represents an increase of 1,645,000 tons over production for the first eight months of 1947, exceeding the total output of the entire year 1939 or any other year in the thirties.

If steel-making operations for the next four months are maintained at the rate of the past four months, total production for 1948 will be about 87,000,000 tons, another peacetime record, the Institute predicts.

Expert Advises Relocation of Industry and Public Works to Combat Atomic Warfare

TRADITIONAL CONCEPTS OF public works and urban planning must be abandoned "because they invite disaster in this atomic age," J. W. Follin, Assoc. M. ASCE, assistant administrator of the Federal Works Agency, states in the August issue of *Public Construction*, monthly publication of the FWA. Discussing a recent report of the National Securities Resources Board, on which he is liaison official for the FWA, Mr. Follin emphasizes the fact that, "We must develop a new basic prescription for urban redevelopment predicated on national responsibility for industrial population dispersion."

Although underground installations probably provide maximum protection against atomic warfare, according to the Board, Mr. Follin reports that they are not considered economically justified for application on a large scale. This is also true of above-ground facilities, employing fire, blast, or radiation-resistant materials. Indicating that "dispersion is considered the most practical solution to the problem of strategic location," he adds that solution of the problem "must reflect a judicious balance between economic feasibility and reasonable strategic security."

Among the difficulties to be overcome in the dispersal of production facilities, Mr. Follin stresses the importance of making public facilities and services available, pointing out that, "Much of our modern industrial pattern is dependent upon adequate highways to facilitate the receipt of raw materials and the distribution of finished products; the provision of sewer and water lines, and facilities such as schools, hospitals, recreational developments, police and fire protection—the whole gamut of public works we take for granted in our established communities. We would still be confronted with the familiar problem of providing industrial workers with the means of living a normal life in a normal community with an acceptable standard of living. This is a point that has relevance not only to the problem of military, but also peacetime security. Our experience in the recent war suggests that any plan to disperse our industrial plant will be thwarted if we do not have at hand people to man the plants."

As a solution to the problem, the Security Board recommends urban communities of not more than 50,000, to be separated from other communities by open countryside. This solution is based on the belief that such communities will, in most cases, be too small for atomic attack because of the tremendous cost of atomic bombs. "Some of these communities of 50,000 population might be developed as new cities, as proposed in Great Britain," according to the Board. "Or they might be developed as a result of expansion of our many desirable smaller towns and hamlets dotted over extensive regions of open country, as well as those located in the environs of our larger cities."

Pointing to the fact that for some years there has been a move toward decentralization of large metropolitan communities, which has been occurring as "an unregulated sprawl, circling and spreading around the larger cities, instead of the orderly process of dispersion now so urgently needed," Mr. Follin states that the intelligent conduct of this dispersion is the concern of all. Specifically, he recommends immediate attention to the problem on the part of federal, state, county, and city officials and other authorities.

Parking Garage Planned at Brooklyn-Battery Tunnel Entrance

SEVEN-STORY PUBLIC HOUSING GARAGE, being built at estimated cost of $3,500,000 near Manhattan end of Brooklyn-Battery Tunnel, will provide parking space for more than 1,000 cars in congested area of New York City. Scheduled for completion in fall of 1949, project will facilitate efficient use of tunnel. Photograph furnished by Triborough Bridge and Tunnel Authority.

Break-Through Is Made in Brooklyn-Battery Tunnel

HOLING-THROUGH OPERATIONS in one tube of the $77,000,000 Brooklyn-Battery Tunnel, which will connect Manhattan and Brooklyn under the East River, were recently completed by blasting a final 4-ft section of rock. The holing through of the second tube, carrying the Brooklyn-bound portion of the traffic, will take place in a few weeks.

The 9,117-ft tunnel, longest in the United States, will have four 24-ft 4-in. lanes, making possible the trip between Battery Park in Manhattan and the Red Hook section of Brooklyn in three and a half minutes. Proposed arterial highways will connect the tunnel terminals with Long Island on the one side and Manhattan, Westchester and New Jersey on the other. An article on the Brooklyn-Battery Tunnel appeared in the September issue, page 22.

Rise in Construction Work East of Rockies Is Noted

BUILDING AND CONSTRUCTION contracts awarded in the 37 states east of the Rocky Mountains neared the billion-dollar mark in July, bringing the cumulative investment commitment volume for the year through July to a point 38 percent higher than that reported for the first seven months of 1947, according to the F. W. Dodge Corp., fact-finding organization for the construction industry. Total contracts for these states in July of the current year amounted to $962,685,000—an increase of 46 percent over that reported for July 1947 and 3 percent above the total for June of this year.

These sharp gains were reflected in all major construction classifications, with the non-residential volume up 56 percent over July of last year and 8 percent over June of this year, and residential construction up 45 percent over July 1947 and down 2 percent from the June 1948 estimate. Heavy engineering works increased 31 percent over July 1947 and 1 percent over June 1948.

Undergraduate Award and Scholarship Program Open

ENTRIES IN THE annual undergraduate engineering award and scholarship program, conducted by the James F. Lincoln Arc Welding Foundation, may be submitted until April 1, 1949, according to an announcement from the Foundation. The current competition, second in a ten-year series, offers engineering undergraduates (including agricultural engineers) an opportunity to compete for cash prizes of from $25 to $1,000 and scholarship awards, ranging from $250 to $1,000. These awards will be given for the best papers on various aspects of welding.

Details of the contest may be obtained from the James F. Lincoln Arc Welding Foundation, Cleveland 1, Ohio.

Long-Range Sprinkler Used for Irrigation in South

SPRINKLERS, operated by pumps forcing water through portable quick-coupler pipes, prove effective for supplemental above-tree irrigation in Georgia. With discharge capacity of 500 gpm at 100-lb pressure, device covers three-acre area. These and similar sprinklers, recently developed by E. H. Davis, Assoc. M. ASCE, irrigation engineer for Georgia Agricultural Extension Service (at right in photo), have been used in irrigating 3,500 acres in 60 counties.

Construction Roundup

From the Construction Industry Information Committee—Washington, D. C.

MILLIONS OF DOLLARS are being spent each year by the construction industry in an effort to reduce building costs, improve materials and methods, and discover new products.

The specifications for most of today's new buildings would have been impossible in many respects 25 years ago. Hundreds of new products and improvements in materials and methods have literally revolutionized the industry in the meantime. The available figures show only a portion of the funds devoted to research. At least $15 million a year is being spent on organized technical research carried on by manufacturers or groups of manufacturers under controlled conditions. Large amounts also are spent by universities, technical colleges, and institutes, and about $1,500,000 annually by federal agencies.

Over-all production of building materials during the first half of 1948 exceeded the record-breaking rate set in 1947, and manufacturers' and dealers' inventories of key materials showed substantial improvement.

An analysis by the committee's economists indicates that, with the possible exception of certain steel items, the supply of materials and equipment will be adequate to meet all construction requirements during the remainder of this year. However, that statement necessarily is based on the assumption that the available supply will not be reduced by transportation difficulties, expansion of the preparedness program, or serious work stoppages in basic industries, such as steel, coal, and transportation.

New Machine Simplifies Continuous Steel Casting

CONTINUOUS CASTING OF steel from liquid form to semifinished shape in one simple relatively inexpensive machine is now possible through a joint development of the Republic Steel Corp. and the Babcock & Wilcox Tube Co., according to a recent announcement of the two organizations. It is claimed that the new process, perfected after six years of research, opens up possibilities of utmost importance to the entire steel industry through increasing productivity and decentralizing production by simplification of apparatus and by increasing the final yield of steel from the original melt.

Technical advantages claimed for continuous casting over the conventional method include faster cooling, resulting in a fine and uniform crystalline structure with little segregation. Continuous casting also offers less opportunity for dirt or other foreign material to enter the castings, producing in general a surface free of checking and scabs and an interior without entrapped slag.

Army Engineers to Build New Dam on Monongahela

RECENT GROUND-BREAKING ceremonies at Morgantown, W.Va., initiated construction of the $6,343,650 Morgantown Lock and Dam, to be built by the Corps of Engineers on the Monongahela River. With modern locks sized to accommodate standard coal tows, the new dam will for the first time enable shipment of coal from the mining areas around Morgantown by water to Pittsburgh and points beyond.

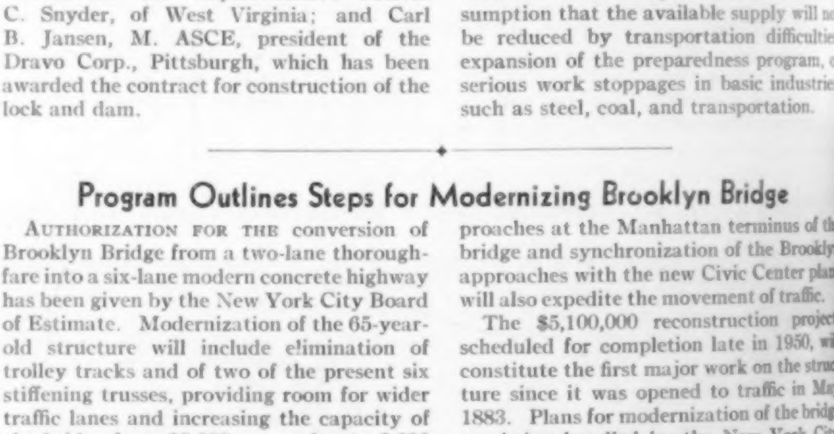
Located about 100 miles above the "point" in Pittsburgh, the new structure completes the chain of eight modernized dams on the Monongahela between Morgantown and Pittsburgh. The Morgantown Dam is being built just above the present dam No. 10, which it will replace. Dam No. 11, further up the river, will also be made obsolete by the project. The lift of the new dam will be 18 ft, highest on the Monongahela, and its six gates will permit easy control of the pool above and aid regulation of its height during flood stages. Construction is expected to take approximately three years.

Sponsored by the Morgantown Chamber of Commerce, the ceremony was attended by Gen. J. C. Mehaffey, division engineer for the U.S. Engineer Office at Cincinnati; Col. F. H. Falkner, U.S. district engineer from Pittsburgh; U.S. Senator Chapman Revercomb and Representative Melvin C. Snyder, of West Virginia; and Carl B. Jansen, M. ASCE, president of the Dravo Corp., Pittsburgh, which has been awarded the contract for construction of the lock and dam.

Program Outlines Steps for Modernizing Brooklyn Bridge

AUTHORIZATION FOR THE conversion of Brooklyn Bridge from a two-lane thoroughfare into a six-lane modern concrete highway has been given by the New York City Board of Estimate. Modernization of the 65-year-old structure will include elimination of trolley tracks and of two of the present six stiffening trusses, providing room for wider traffic lanes and increasing the capacity of the bridge from 20,000 cars a day to 6,000 an hour. Construction of underground approaches at the Manhattan terminus of the bridge and synchronization of the Brooklyn approaches with the new Civic Center plans will also expedite the movement of traffic.

The $5,100,000 reconstruction project, scheduled for completion late in 1950, will constitute the first major work on the structure since it was opened to traffic in May 1883. Plans for modernization of the bridge are being handled by the New York City consulting firm of D. B. Steinman, M. ASCE.



DRAWN FROM ORIGINAL PLANS of John A. Roebling, M. ASCE, builder of Brooklyn Bridge, this view is considered exceptionally beautiful.

Proposed Western Projects Announced by Bureau of Reclamation

In its *Advance Construction Bulletin* for September 1, under the head of "Bid Calls Expected This Month," the Bureau of Reclamation lists large Western construction projects on which work is about to begin. As usual this information is not final, but data listed will give an idea of the nature, size, and location of the proposed projects.

EARTHFILL DAM
Missouri Basin Project, Kansas

Location: On the Smoky Hill River about 14 miles south of Ogallah, Kans.

Work: Construction of Cedar Bluff Dam, an earthfill structure approximately 134 ft high and 12,500 ft long.

Excavation (common) for foundation of dam	1,100,000 cu yd
Excavation (all classes) for outlet works and spillway	1,300,000 cu yd
Excavation (common) and transportation to dam	9,000,000 cu yd
Earthfill in embankment	7,800,000 cu yd
Quarrying, transporting and placing riprap	211,000 cu yd
Furnishing and placing gravel blanket	106,000 cu yd
Concrete in spillway and outlet works	46,000 cu yd
Furnishing and handling cement	74,000 bbl
Furnishing and placing reinforcing steel	5,000,000 lb
Installing high pressure gates, valves, and control	104,500 lb
Installing outlet pipe	112,000 lb
Installing all other metalwork	51,000 lb

Time Allowed for Completion: 1,300 days

CANAL
Central Valley Project, California

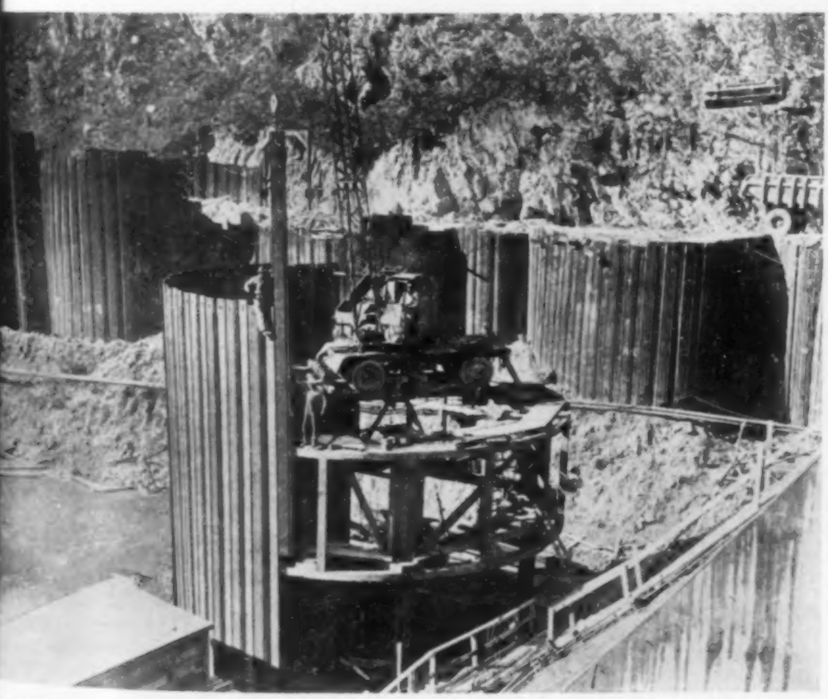
Location: Near Porterville, Calif.

Work: Construction of earthwork, canal lining, and structures for about 27 miles of the Friant-Kern Canal.

Excavation	4,566,800 cu yd
Concrete in structures	25,480 cu yd
Concrete in lining	143,070 cu yd
Furnishing and placing reinforcing steel	4,323,000 lb
Furnishing and handling cement	241,100 bbl

Time Allowed for Completion: About 700 days

Elevated Crane Sets Steel Sheetpiling for Allatoona Cofferdam



Mounted high atop timber pedestal, self-propelled crane has reach required to set steel sheetpiling for secondary cofferdam at Allatoona Dam, Corps of Engineers flood control and power project on Etowah River, Georgia. Loraine TL-20 crane was lowered into position by cableway which it first helped assemble. Dam is concrete gravity-type structure, 1,225 ft long at crest and 200 ft high.

Member Is Posthumously Honored by Congress

Tribute was paid to the late Sidney B. Williamson, M. ASCE, builder of the Pacific locks of the Panama Canal, by the 80th Congress, which ordered printed in the Congressional Record a eulogistic address by Harry O. Cole, M. ASCE, resident engineer on the Canal. Mr. Coles' tribute, originally delivered at the 1948 annual meeting of the Panama Canal Societies of the United States, cites Colonel Williamson as one of the "great leaders, great engineers, and men of vision" responsible for the Canal. "No man on the Canal showed greater resourcefulness and ability in overcoming the scores of difficulties encountered on the construction work than Colonel Williamson," he said.

Placed in charge of the building of the Pacific locks in December 1907, Colonel Williamson later became head of the entire Pacific division. Two years ago he was honored by a special Canal Zone stamp issue bearing his likeness. He died in 1938.

Army Dedicates Technical, Cultural Center in Munich

An American information center, largest of eleven in Bavaria, was recently dedicated in Munich by Maj. Gen George P. Hays and Murray D. Van Wagoner, M. ASCE, land director of the Office of Military Government for Bavaria. Located in the "Fuehrerbau," former headquarters of the Nazi party, the center includes a 10,000-volume library of books on technical and other subjects in English and German; a music library; rooms for study, lectures, and discussions; and a large movie auditorium now under construction.

In the dedication ceremonies, Mr. Van Wagoner pointed to the significance of locating the center in a building that a few years ago was a "key installation in a system which burned books, censored the press, banned foreign radio programs, and cut off a nation from free cultural contact with the outside world." It is our purpose, he said, "to promote and enlarge the free exchange of culture and information between Germany and other nations."

Engineer Positions Open in State of Washington

Applications for engineering positions in the Washington State Board of Health will be accepted until further notice. Positions available at present include those of public health engineer, with a salary range of $3,360 to $4,080, and senior public health engineer, carrying a salary of $3,900 to $4,800. Examinations for these positions consist of a rating of education and experience, with preference given to veterans.

Information and application forms are available from the Washington State Personnel Board, 1209 Smith Tower, Seattle 4, Wash.

Civil Engineers May Now Apply for Army Commissions

UNDER A NEW policy adopted by the Department of the Army, it is now possible for engineers without previous military training to receive appointments in the Officers Reserve Corps. Ranks range from second lieutenant through colonel, depending on age, education, and experience.

At present the Highway Transport Service Division of the Transportation Corps Reserve is inviting applications from civil engineers who can qualify as Highway Engineer Specialists, Highway Planning Engineer Specialists, Traffic Engineer Specialists, and Safety Engineer Specialists. In addition to a bachelor's degree in civil or a related field of engineering, applicants must have had experience in: (1) construction of housing, commercial or industrial buildings, bridges, and terminal facilities; (2) structures, including streets and highways, communication system lines, highway traffic control systems, and parking facilities; or (3) street and highway improvement programs, traffic surveys, and volume, origin, and destination studies.

Although exceptions may be made in special cases, maximum age limits are in general: 30 years for second lieutenant, 33 for first lieutenant, 37 for captain, 45 for major, 51 for lieutenant colonel, and 55 for colonel.

Further information and application blanks may be obtained from any Army installation, National Guard or Reserve unit, or from the Army Commander of the Corps area in which the applicant resides.

1948 Highway Construction Is Seen as Setting Record

SPENDING FOR ROAD building will break all records in 1948, Charles M. Upham, M. ASCE, engineer-director for the American Road Builders' Association, predicted in a recent conference with road officials. Basing his prediction on the uniform rate of construction increase since 1945, Mr. Upham stated, "If the upward trend is maintained, we should hit the $1^3/_4$ billion mark this year.

"October is our peak construction month," he pointed out. "In October 1946, $100 million was spent in road building. In October 1947, this rose to $178 million. At this rate, October 1948 should show a total expenditure of $250 million. The yearly ratios show practically the same increases—from $772 million in 1946 to $1^1/_2$ billion in 1947."

Mr. Upham quoted Federal Works Agency figures to show that state highway department contracts for the first five months of 1948 amounted to 38 percent more than for the corresponding period of 1947. Federal-aid contracts awarded in May of this year were 30 percent higher than those let in May 1947, and state highway contracts for the same month were 31 percent above those awarded in May 1947. Total highway contracts at all government levels for May 1948 were 41 percent over those of May 1947.

However, despite these increases in the highway construction program, Mr. Upham warned, they are "still far from sufficient to overcome the deficiencies in our highway system. We must make even greater gains to restore and extend our highways."

Structural Design Textbook Receives Award of $5,000

WINNERS OF A joint award of $5,000, given by the James F. Lincoln Arc Welding Foundation in its annual Textbook Award Program, are two ASCE members—Prof. C. D. Williams, head of the civil engineering department at the University of Florida, and Prof. E. C. Harris, chairman of the department of structural engineering at Fenn College. The award is made for their coauthorship of a textbook manuscript, entitled *Structural Design in Metals*, selected by a jury of engineers as the best modern textbook mansucript in the structural engineering field.

The Irwin-Farnham Publishing Co., of Chicago, Ill., will publish the new textbook, which will be ready for distribution early in 1949.

Refresher Courses Given for New York State Examinations

REFRESHER COURSES TO prepare engineers for the New York State professional examinations are being conducted in the Engineering Societies Building in New York under joint sponsorship of the metropolitan sections of the ASME and the AIEE. Of particular interest to civil engineers are the courses in structural planning and design, basic engineering sciences, and engineering economics and practice.

Leaflets describing the courses and giving dates, times, places and fees may be obtained from either A. T. Kniffen, c/o Air Reduction Sales Corp., 295 Madison Avenue, New York 17, or Mr. A. H. Moore, c/o General Electric Co., 570 Lexington Avenue, New York 22, or from the headquarters of the ASCE, ASME, or AIEE, 29–33 West 39th Street, New York 18.

Other refresher courses with established reputations available in the city include one offered under the auspices of the Cooper Union Alumni Association, 313 West 53d Street, New York City.

National Directory of Safety Films Available

FOR SAFETY EDUCATION in business and industry, on streets and highways, on farms, and in homes and schools, the National Safety Council, in cooperation with *Business Screen Magazine*, has prepared a comprehensive listing of 403 motion pictures and slides on the subject. The list is classified and indexed with a synopsis of each film, and a statement as to its type, source, and availability for purchase, rental or loan. It may be purchased from the National Safety Council, 20 North Wacker Drive, Chicago 6, Ill., at a cost of 25 cents.

Meetings and Conferences

American Chemical Society. T Chicago section of the American Chemi Society will hold its fifth national chemi exposition and industrial chemical conf ence at the Coliseum in Chicago, Ill., Oc ber 12–16.

American Institute of Electrical En neers. The Middle Eastern district me ing of the American Institute of Electri Engineers, featuring air and marine tra portation, will be held in Washington, D. with headquarters at the Statler Ho October 5–7.

American Management Associat Office management will be the theme of t American Management Association meet in the Hotel Pennsylvania, New York, N. October 26–27.

American Public Works Associat The 54th annual conference of the Ameri Public Works Association will be held Boston, Mass., at the Copley Plaza Ho October 17–20.

American Society for Metals. Sponso by the American Society for Metals, t 30th annual national metal congress a exposition will be held in the Commer Museum and Convention Halls of Philad phia, Pa., October 25–29. Meeting sim taneously are: The American Weld Society, the Institute of Metals Division the American Institute of Mining a Metallurgical Engineers, and the Soci for Non-Destructive Testing.

American Society for Testing Materi The Philadelphia district meeting of t American Society for Testing Materials to be held at the Franklin Institute Philadelphia, Pa., October 13. He quarters for the Washington district meet of the American Society for Testing M terials will be the Wardman Park Ho Washington, D.C., October 14.

American Society of Planning Offici General and technical sessions, schedu for the national planning conference of t American Society of Planning Officials, w be held at the New Yorker Hotel, New Yo N.Y., October 11–13.

American Society of Sanitary Engine ing. The annual meeting of the Ameri Society of Sanitary Engineering is to held in Phoenix, Ariz., beginning October Requests for reservations should be made George Marks, State Capitol Bldg., Phoen Ariz.

American Standards Association. T annual meeting of the American Standar Association will take place at the Wald Astoria, New York City, October 20–22.

American Welding Society. Headqu ters for the 29th annual meeting of t American Welding Society will be Bellevue-Stratford Hotel, Philadelphia, during the week of October 24.

Engineers' Society of **Western Pennsylvania.** The ninth annual water conference of the Engineers' Society of Western Pennsylvania will take place at the Hotel William Penn in Pittsburgh, Pa., October 18–20.

National Conference on Industrial Hydraulics. Headquarters for the fourth annual meeting of the National Conference on Industrial Hydraulics, sponsored by the Armour Research Foundation of Illinois Institute of Technology, will be the Hotel Sheraton, Chicago, Ill., October 20–21.

National Safety Council. The 36th national safety congress and exposition of the National Safety Council will be held in Chicago, Ill., October 18–22. Five leading hotels will house the safety sessions and expositions October 18–22—construction section meetings are to be held at the Stevens Hotel on October 19 and 20.

Society of Automotive Engineers, Inc. The national aeronautic meeting and aircraft engineering display of the Society of Automotive Engineers, Inc., is scheduled to take place at the Hotel Biltmore, Los Angeles, Calif., October 6–9.

R. Robinson Rowe, M. ASCE

"Most hard problems," mused Professor Neare, "are easy after we learn how to do them, and many impossible problems are only a little bit harder—harder, that is, to find the easy way. Joe, how did you classify the problem of 6 moments in Gooey Gulch?"

"Impossible," blurted Joe Kerr. "From symmetry, if the maximum moment in the left half of the girder is increased 69 percent when the prop settles, that in the right half increases the same, and not 96 percent. At first I thot there was an error of transposition, but you said the moment over the prop increased 165 percent, which is the sum of 69 and 96 percent and neither a coincidence nor common sense."

"Sounds to me," said Cal Klater, "as if Joe tackled the problem the hard way. He assumed the prop was at mid-span to make the equations simpler, but he made the equations inconsistent and the problem impossible. Suppose instead we let the two part spans be a and b, draw the simple moment diagram ASB (Fig. 1) with CS the moment at the point where the prop is to be put, and construct TT' tangent to the curve at S. Then AT, CT and BT' can be marked ka^2, kab and kb^2, where k in this case is 500, half the unit load.

"When the girder was propped up 5 in., it had the effect of moving the moment base from ACB to ADB. Suppose we let f and g be the maximum moments in the two part spans and h be the moment over the prop. When the prop settled x in., the moment base dropped to AEB, where $SE = 2.65h$ and the two maximum moments can be marked $1.69f$ and $1.96g$.

"We can write some simple equations if we recall the inset relation between the maximum ordinate to a parabola m and the secant and tangent offsets s and t, viz:

$2\sqrt{fka^2} = h + ka^2$ and

$2\sqrt{1.69fka^2} = 2.65h + ka^2$, whence
$1.3(h + ka^2) = 2.65h + ka^2$, so that
$0.3ka^2 = 1.35h$, and analogously,
$0.4kb^2 = 1.25h$, producing,
$0.12k^2a^2b^2 = 1.6875h^2$, or
$kab = 3.75h$, so that finally

$$x = 5\,\frac{DE}{DC} = 5\,\frac{1.65h}{2.75h} = 3 \text{ in."}$$

That last sentence left Cal winded, but the Professor said it was correct, mathematically and grammatically, pointing out also that the solution was independent of load and span, that the prop was 18 ft from the left support and that all pertinent distances and moments could be expressed without radicals.

"Our new problem," he concluded, "involves peanuts instead of cocoanuts, to distinguish it from a special case you have already solved. A survey party found the peanuts in a barrel down a gully where it had rolled from a passing truck, and agreed to divide them in proportion to their families. The chief-of-party was a bachelor, but the transitman rated 9 shares and the

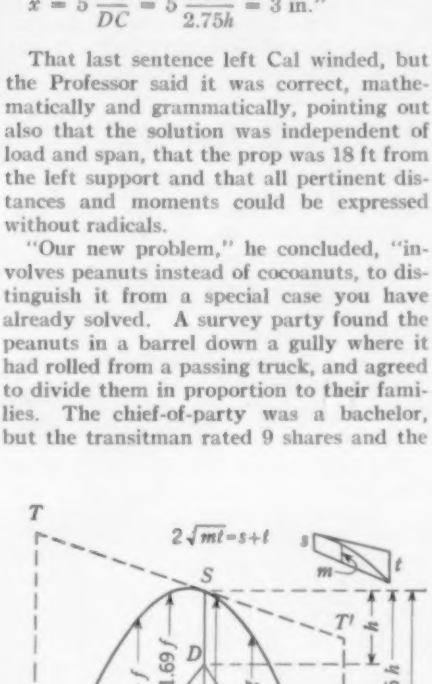


FIG. 1. Eccentric Prop at Gooey Gulch.

chainmen 3 and 7, respectively, making 20 shares in all. Each woke up worried during the night, divided the contents of the barrel, ate the one left over, cached his portion and put the rest back in the barrel. Next morning they divided those left by the same rule and threw the odd one to a pack rat. If the chief got 2,144 peanuts, how many did the transitman get?"

[Cal Klaters this month were Richard Jenney, W. D. Dickinson, Jr., and Edward C. Holt, Jr., all using "easy" ways.]

NEW IN *Education*

To increase the general effectiveness of professional and subprofessional personnel in the Florida State Road Department, the University of Florida civil engineering department in cooperation with the Road Department is offering twelve-week courses to department employees. The objective of the program is to train, over a period of years, all the engineering personnel in the department, from the grade of rodman through that of assistant division engineer, in nearly all phases of highway design and construction. The courses are being conducted under the supervision of Radnor J. Paquette, assistant professor of civil engineering.

Starting with the fall semester, the civil engineering department of the University of Michigan College of Engineering is offering an undergraduate elective option in the construction field. This course will give special training in construction methods, cost analysis, estimating, and accounting to civil engineering students planning to enter the construction and contracting fields. For the time time, also, the department will offer a graduate program in construction engineering, leading to the M.S.E. degree, to qualified students holding the B.S. degree in civil engineering.

Fellowship Program Will Be Reestablished at MIT

Reestablishment of its fellowship program, with a grant of $225,000 to the Massachusetts Institute of Technology for a three-year program of research, was announced recently by the Alfred P. Sloan Foundation. The project, carried on for a number of years prior to 1942 and discontinued during the war, will be a cooperative activity of the departments of business and engineering administration and economics and social science and will be started in the fall of 1949.

Fellowships will be awarded, under the program, to young business executives who show outstanding promise for leadership in their own companies and for service in industrial society. They will attend MIT on one-year leaves of absence from their employing companies, participating in seminars and making field trips. The program aims to develop for positions of higher responsibility young executives of outstanding capacity, proved managerial ability, and demonstrated awarness of the social effects of industry. A fundamental study of the means for developing young executives is already under way, and plans are being made for a selection of men best fitted to benefit from the program.

NEWS OF *Engineers*

Bertram D. Tallamy, of Buffalo, N.Y., has been appointed superintendent of the New York State Department of Public Works, with offices in Albany. As chief engineer of the department since January 1945, Mr. Tallamy supervised the state's $840,000,000 postwar program of public works construction and reconstruction. Prior to his connection with the department, Mr. Tallamy was a member of the Buffalo engineering firm of Fretts, Tallamy & Senior, & Forrestel. In his new capacity, he succeeds **Charles H. Sells,** who has resigned to enter private practice.


B. D. Tallamy

Hans A. Einstein, hydraulic engineer and member of the University of California faculty, is at present in Omaha, Nebr., engaged in a sedimentation study of the Missouri River for the Army. Dr. Einstein is a son of the famous physicist, Albert Einstein.

George E. Nagele was recently named district highway engineer for the Pennsylvania State Highway Department, with headquarters at Hollidaysburg. With the exception of five years in private practice, Mr. Nagele has been with the Highway Department since 1915.

H. G. Creel, Jr., is assuming the post of city engineer of Denton, Tex. Following his discharge from the Army, in which he served overseas, Mr. Creel was with the Dallas consulting firm of Koch & Fowler, the Veterans' Administration at Dallas, and the Dallas office of the Corps of Engineers.

R. E. Edgecomb has resigned as associate professor of civil engineering at the University of Nebraska to accept an appointment as structural engineer in the Army Corps of Engineers, with headquarters in Omaha. He will be engaged on Missouri River Basin development work.

Richard C. Elstner has resigned as assistant professor of civil engineering at Rose Polytechnic Institute in order to accept a similar position at the University of Hawaii. He will be succeeded by **James E. Levings,** formerly assistant professor of architecture at Kansas State College.

Maj. Gen. Glen E. Edgerton was recently appointed president and resident member of the Beach Erosion Board of the Army Corps of Engineers, Washington, D.C. General Edgerton served for a number of years as governor of the Panama Canal Department of the Army.

Saul S. Ganick, special assistant to the New England division engineer of the Army Corps of Engineers, has accepted a position with the J. Slotnik Co., Boston builders. Mr. Ganick recently returned from a two-month special assignment in the Pacific Northwest, where he assisted in the preparation of the Corps of Engineers Columbia River report. He has been with the Army Engineers in various capacities for the past 13 years.

Earl D. Krapf has been promoted from the position of assistant engineer in the Wilmington, Del., Street and Sewer Department to that of assistant chief engineer.

Maj. R. M. Whitenton was recently assigned to the Tulsa, Okla., District office of the Corps of Engineers.

Harold A. Kemp has been appointed consultant on engineering for the Office of Civil Defense Planning. In addition, he will continue to serve as director of sanitary engineering for the Government of the District of Columbia, Washington, D.C.

James P. Exum has severed his connection as bridge engineer for the Texas State Highway Department at Austin to join the consulting firm of Howard, Needles, Tammen & Bergendoff, with headquarters in New York City.

Lawrence E. Hough, formerly city engineer of Ontario, Ore., is now employed in a similar capacity at Aberdeen, Wash.

Arthur S. MacGregor has been promoted from senior to associate engineer in the New York State Department of Public Works. He has charge of the state's building operations in District 5, with headquarters in Buffalo.

C. Carter Brown and **Charles M. Butler** have formed the civil engineering firm of Brown & Butler, with offices in Baton Rouge, La.

Brig. Gen. George J. Nold, staff engineer of the First Army, has been assigned to new duties as division engineer of the North Atlantic Division. He will be stationed in New York City.

Frank Bachmann, for the past 28 years on the staff of the Dorr Co., has moved to Orlando, Fla., where he will handle all the sanitary engineering work for the company in the state.

Norman H. Collisson, special assistant to Secretary of the Interior J. A. Krug, has been appointed deputy at the Frankfort, Germany, headquarters of the Economic Cooperation Administration. Mr. Collisson has been aiding ECA activities in the Interior Department for several months, and at one time was chairman of a technical mission surveying German industries.

Hugo G. Erickson is now city engineer of Minneapolis, Minn., succeeding **F. T. Paul,** who retired early in the summer. A wartime officer in the Army Air Corps, Mr. Erickson recently held the position of assistant city engineer in the Minneapolis Engineer Department.

Arthur H. Adams, of Long Beach, Calif., has been appointed chief engineer of the Los Angeles County Regional Planning Commission. During the war Mr. Adams served as acting chief engineer of the Commission, and he was at one time public service director for the City of Long Beach.

George M. Tapley, for some years in charge of civil works project planning for the Office of the Chief of Engineers in Washington, D.C., has accepted a transfer to the Alaska Road Commission, Interior Department, Juneau, Alaska, where he will be assistant chief engineer in charge of contract work for the construction and hard surfacing of highways.

Joseph L. Burkholder, general manager and chief engineer of the San Diego County Water Authority, recently received a distinguished alumni citation from the University of Kansas. Mr. Burkholder, who was graduated from the university in 1908, was honored "in recognition of his genius as a civil engineer who, through years of devotion to public service, has contributed richly to the health, wealth, and development of Southern California and other southwestern areas of our country."

Lawrence Adams, formerly a partner in the engineering firm of Bundy & Adams, Modesto, Calif., has established his own civil engineering practice in Modesto. His headquarters are in the Modesto Bank & Trust Company Building.

NATIONAL TRAFFIC Safety Contest Award of National Safety Council, honoring California as first of Western states in traffic engineering advancement during past year, is presented to State Highway Engineer George T. McCoy (center) and John W. Vickrey, assistant state highway engineer (right) by Director of Public Works Charles H. Purcell in recent ceremony. All three engineers are members of Society.

William F. Moehlman, on the engineering staff of the Knoxville Concrete Products Co., Knoxville, Tenn., was recently honored by reelection to a second term as president of the Knoxville Chamber of Commerce. Noted for his civic interests, he is director of the Good Government Group and the Knoxville Tourist Bureau and former chairman of the local Committee for Economic Development. Two of the outstanding features of his administration of the Chamber of Commerce have been increases of membership from 775 to 2,445 and of the budget from $18,000 to $60,000. Active in ASCE and Local Section activities, Mr. Moehlman served as chairman of the Postwar Planning Committee of the Knoxville Sub-Section from 1941 to 1945, vice-president of the Knoxville Sub-Section in 1941, and president of the Tennessee Valley Section in 1946.


W. F. Moehlman

Edmund C. Garthe will head the Land and Air Carrier Section of the Sanitary Engineering Division of the Public Health Service, succeeding **H. Norman Old** who has been assigned to the Bureau of Medical Services. Mr. Garthe has been with the Public Health Service since 1936—most recently as district engineer for the Chicago District. In his new capacity, he will be stationed in Washington, D.C.

M. J. Shelton, since January 1946 construction engineer for La Mesa Lemon Grove and Spring Valley Irrigation District, has been promoted to the post of manager and chief engineer. During the war Mr. Shelton was on active duty with the Army Corps of Engineers in Brazil, where he was in charge of the construction of airport runways, buildings, and utilities. He is president of the San Diego Section of the Society.

Terrence J. Owens, a former major in the 1140th Engineer Combat Group during World War II, is now city engineer of Denver, Colo.

J. Graham Daniels, until recently contracting engineer for the Chicago Bridge & Iron Co., Chicago, has been appointed sales manager of the organization's new office in Salt Lake City, Utah.

Earl Sorenson is leaving San Diego, Calif., where he has been construction engineer for the California Division of Highways, to assume new duties as head of the Equipment Section of the Division of Highways. His headquarters will be in Sacramento.

Neal Smith recently resigned as assistant city manager of San Diego, Calif., to become the first city manager for Santa Cruz.

Rufus W. Putnam has opened a consulting engineering office under his own name in Los Angeles, Calif. Until lately manager of the Los Angeles office of Kaiser Engineers, Inc., Colonel Putnam was wartime district engineer for the Los Angeles District of the Corps of Engineers.

Dan H. Pletta was recently made head of the department of applied mechanics at Virginia Polytechnic Institute. He has been on the VPI faculty since 1932, most recently in the capacity of professor of applied mechanics. During the recent war Professor Pletta served as a major in the mechanics department at the U.S. Military Academy at West Point and with the Philadelphia Ordnance District.

Joseph B. Brooks has resigned as engineer assistant to the president of the Board of Public Service of the City of St. Louis to accept a position as civil engineer assistant to his father, **Robert B. Brooks,** St. Louis consultant.

Donald Derickson, professor emeritus of the civil engineering school at Tulane University, received the honorary degree of doctor of science from Allegheny College, Meadville, Pa., during the past commencement season. During his long tenure on the Tulane staff, Professor Derickson served as Faculty Adviser to the ASCE Student Chapter there.

August G. Sperl, John F. Gowen, and **Charles J. Gregory** announce the formation of the engineering and contracting firm of Sperl, Gowen & Gregory, Inc., with headquarters in New York City. The new firm will specialize in foundations, underpinnings, piles, shafts, tunnels, cofferdams, subways, and other construction.

Col. W. W. Wanamaker assumed command of the New York District of the Army Corps of Engineers on September 1. Colonel Wanamaker has completed many assignments for the Corps since his graduation from West Point in 1918, including wartime service in the New Guinea and Philippine campaigns, and peacetime posts as deputy division engineer of the Missouri River Division and district engineer of the Baltimore District. As organizer and first district engineer of the Garrison, N.Dak., District, he initiated construction of the $200,000,000 Garrison Dam. In his present capacity as district engineer for the New York District, he will direct construction of five large veterans' hospitals; flood control projects; the maintenance and improvement of rivers and harbors; and the construction of camps, posts, and airfields in New York, New Jersey, and Delaware.


W. W. Wanamaker

Verne O. McClurg, was installed as president of the Western Society of Engineers at its annual meeting in Chicago. Mr. McClurg is a partner in the Chicago architectural and engineering firm of Mundie, Jensen and McClurg. During World War I, he was supervisor of the construction work at the U.S. Naval Base at Norfolk, Va. Ralph Budd, president of the Burlington Lines' has been elected an honorary member for "outstanding contributions to the engineering profession."

Deceased

Sir Robert Gales (M. '13) retired cons[ul]tant of London, England, died on July [...] His age was 83. From 1919 until his reti[re]ment in 1937, Sir Robert was a member [of] the London consulting firm of Rend[el,] Palmer & Tritton. Earlier in his career [he] had served as chief engineer of the Gover[n]ment of India Railway Board at Sim[la,] India.

Farrar Petrie Hamilton (Assoc. M. [...]) retired engineer of New Orleans, La., d[ied] on August 15. Mr. Hamilton, who was [...] was engaged in engineering work in N[ew] Orleans for many years. He had be[en] general manager of the Creosoted Materi[als] Co. and area planning engineer for the Pu[b]lic Work Reserve, and for several ye[ars] prior to his retirement was with the W[ar] Production Board there.

Philip Embury Harroun (M. '00) consu[lt]ing engineer of Berkeley, Calif., died [re]cently. His age was 82. A specialist [in] problems of water supply, irrigation, rec[la]mation, and power development, [Mr.] Harroun had maintained a consulting pr[ac]tice since 1909. During this period he ac[ted] in an advisory capacity to the Departm[ent] of the Interior on investigation of the irri[ga]tion and power possibilities of the Sac[ra]mento River and its tributaries; to [the] Water Commission of the East Bay cit[ies] on water supply for the cities of Oakla[nd,] Berkeley, Alameda, and Richmond, and [...] many other agencies. Mr. Harroun h[ad] contributed numerous papers on subjects [in] his field to the ASCE TRANSACTIONS a[nd] other publications.

Ernest Rowland Hill (M. '07) chairman [of] the Board of the New York City consulti[ng] firm of Gibbs & Hill, Inc., died in a hospi[tal] in Orange, N.J., on August 25. He w[as] 76. From 1893 to 1906 Mr. Hill was wi[th] the Westinghouse Electric & Manufacturi[ng] Co.—for five years as chief engineer [in] charge of the British branch of the organi[za]tion—and from 1906 to 1912 he served [as] assistant to the chief engineer on electrific[a]tion of the Long Island Railroad and oth[er] lines. He became a member of the firm [of] Gibbs & Hill in 1912, and from 1924 un[til] recently was president of the firm.

Arthur Raymond Holbrook (M. '[...]) associate materials engineer for the Tenne[s]see Valley Authority at Knoxville, Tenn[.,] died on August 2. Mr. Holbrook, who w[as] 66, had been with the TVA since 19[...] Early in his career (1906 to 1930) he w[as] employed in various capacities by the Ne[w] York City Board of Water Supply and t[he] Department of Water Supply, Gas a[nd] Electricity. He had also spent ten ye[ars] with the New York City engineering firm [of] Fuller & McClintock, serving as ch[ief] engineer for the organization on vario[us] water supply and improvement projects.

Clarence James Kennedy (M. '30) ch[ief] engineer of the Gary, Ind., plant of t[he] American Bridge Co., died recently. M[r.] Kennedy, who was 62, had been with t[he]

American Bridge Co. since 1911. Earlier he was with the Clinton Bridge Works at Clinton, Iowa, and the North Works of the Illinois Steel Co. At the time of his death he was serving as chairman of the ASCE Local Qualifications Committee for District 9.

Bertrus Patrick Larkin (M. '44) vice-president of S. J. Groves & Sons Co., of New York, N.Y., died in that city on August 28. Mr. Larkin, who was 67, had been with the S. J. Groves & Sons Co. for the past 25 years, as vice-president, director, and Eastern manager. Some of the larger construction projects he supervised for the company were the Lend Lease Army Base at Antigua, B.W.I.; enlargement of the Newark Airport for the Army during the war; and the Caracas, Venezuela, Aqueduct Project.

Dan Joseph Lyons (Assoc. M. '37) location engineer for the Arizona State Highway Department, died on July 28. Mr. Lyons, who was 51, had been with the Arizona Highway Department since 1933. Prior to that he was in the engineering department of the city of Tucson, Ariz., with the New Jersey Highway Department and with the Austin Co., of Cleveland.

Henry Hodge Quimby (M. '90) retired consulting engineer of Philadelphia, Pa., died on June 24, at the age of 90. Prior to establishing his own consulting office in 1924, Mr. Quimby was associated for 20 years with the City of Philadelphia Engineering Department, serving successively as assistant engineer of bridges in the Bureau of Surveys and chief engineer in the Department of City Transit. He had designed 60 bridges, including the Walnut Lane span in Philadelphia.

Warren Fuller Rugg (M. '39) retired civil engineer of Bridgehampton, N.Y., died in a hospital in Southampton, N.Y., on August 3, at the age of 70. Mr. Rugg had been associated with the New York State Highway Commission, the Bronx Parkway Commission, and the New York City Board of Estimate. At the time of his retirement in 1946 he was civil engineer for the New York City Planning Commission.

William Drumm Sell (M. '13) of Charleston, W.Va., died on May 29, according to word just received at Society Headquarters. Mr. Sell, who was 79, had maintained a civil and mining engineering practice in Charleston since 1917. Earlier in his career he had been in private practice at Logan, W.Va., and for a number of years he was chief engineer to the Gallego Coal & Land Co. and its successor, the West Virginia Coal Land Co.

Earl Charles Thomas (Assoc. M. '22) consulting engineer of Palo Alto, Calif., died on July 8, at the age of 57. After service in World War I, Mr. Thomas joined the faculty of Stanford University, his alma mater, where he became professor of civil engineering. He resigned in 1944 to enter private practice in Palo Alto under the firm name of Thomas & Whipple. Mr. Thomas had been on the Palo Alto City Council for the past 19 years, and had served a term as mayor.

Ernest Burslem Thomson (M. '04) retired engineer of Portland, Ore., died on October 9, 1942, though the Society has just been notified of his death. He was 79. Born and educated in England, Mr. Thomson had spent most of his career in the U.S. Engineer Office. He had been U.S. assistant engineer at Miami, Fla., Manila, P.I., and, for many years prior to his retirement, at Portland, Ore.

William Chase Thomson (M. '14) civil engineer in the Canadian Department of Public Works, Quebec, Canada, died on August 19, at the age of 82. As a consulting engineer in private practice in Montreal from 1913 to 1925, Mr. Thomson served in an advisory capacity for many Canadian government bureaus. A specialist in bridge construction, he designed numerous notable Canadian spans. At one time he was bridge and structural engineer for the Canadian section of the Joint Board of Engineers for the St. Lawrence Waterway Project.

Charles William Schrage Wilson (M. '05) president of the Wilson & English Construction Co., New York City, died at his home in New Rochelle, N.Y., on August 5. He was 78. Mr. Wilson had spent much of his career as treasurer of the Wilson & English Co., of which he was co-founder. For many years a resident of New Rochelle, he was active in local and civic affairs and had served several terms as village engineer. In 1942 and 1943 he was president of the Associated General Contractors.

Frank Gordon Wolfe (M. '12) consulting engineer of Scranton, Pa., died there on July 8, at the age of 88. Mr. Wolfe had served as construction engineer on the building of the Lackawanna Railroad, and later was chief engineer for the Scranton Coal Co., the Elk Hill Coal & Iron Co., and the Price-Pancoast Coal Co. At one time he was consulting engineer for the New York, Ontario & Western Railroad.

Water Plan Lacks Provisions for Municipal Development

(*Continued from page 24*)

1. Arizona contends that the first 1,000,000 acre-ft above 7,500,000 acre-ft allocated to the Lower Basin is for the exclusive use of Arizona, and that California by its Self-Limitation Act has excluded itself from any part of this water. California denies this, contending that the 1,000,000 acre-ft is part of the "excess or surplus waters unapportioned by said Compact" of which California is entitled to use one-half. California and Arizona differ by 500,000 acre-ft in the interpretation of this item.

2. California contends that Arizona's consumptive use of the Gila waters must be charged against its basin allotment and its main take from the stream reduced proportionately. Arizona contends that it should only be charged with the depletion of the Gila under natural conditions rather than the amount consumptively used. There is a difference of 1,000,000 acre-ft in California's and Arizona's interpretation of this item.

3. There is also a difference of opinion running into several hundred thousand acre-ft between California and Arizona over the charging of evaporation losses which are not specifically covered by the Colorado River Compact or by the contract between the United States and California for the delivery of water.

Arizona and California must know their respective rights. The United States must know these rights before it authorizes such large expenditures as $738,000,000. The Supreme Court is the duly constituted authority to decide such interstate issues and, through more than a century and a half, Americans have become accustomed to recognize its decisions as final and conclusive. The time to decide the controversy is now. Pending such Supreme Court decision, no new project involving diversions of additional Colorado River water in the Lower Basin should be authorized.

Extensive Earthfill Dams Remove Threat of Flood

(*Continued from page 25*)

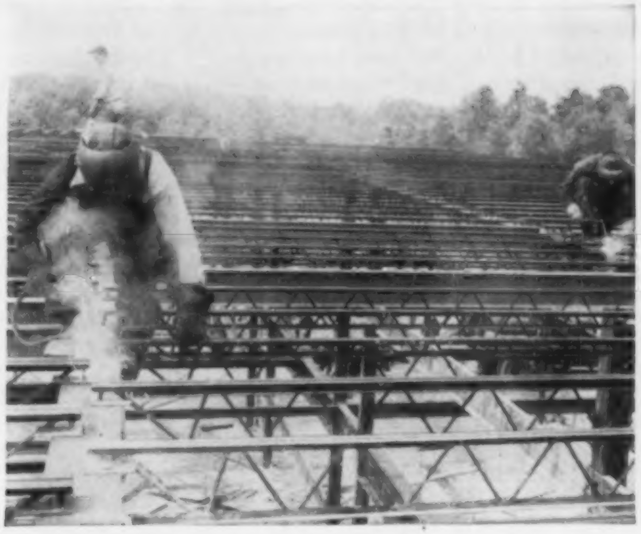
construction will be leased for grazing and farming, and 75 percent of all money collected will find its way back to state and county tax collectors for school and road improvement. In addition to the construction of the two reservoirs, the Buffalo Bayou channel below the dams is being improved by the McGinnes Brothers Construction Co., Houston, at a cost of about $500,000.

Nearly $10,000,000 has already been spent on the entire project by the Corps of Engineers, including $2,900,000 furnished by the Harris County Flood Control District. In addition, Harris County, through a $9,000,000 bond issue voted in November 1944, is carrying out a countywide drainage program under the direction of R. J. Putney, county flood control engineer. This program is being conducted in close cooperation with the Corps of Engineers.

Addicks Dam was constructed by the Corps of Engineers under the supervision of Col. B. L. Robinson, District Engineer of the Galveston District. Norman W. Brown was resident engineer and the contractor was the H. B. Zachry Construction Co. of San Antonio, Tex.

Simplifies Erection of School with Arc Welding

19-ROOM JR. HIGH for South Euclid-Lyndhurst, Ohio, schools. Eventually to comprise 25 rooms plus gym. Architects: C. B. Rowley & Assoc.; Structural Engineer: Frank Eroskey & Assoc.; General Contractors: Leo W. Schmidt Co.; Structural Work: Builders Structural Steel Co. (all of Cleveland).



BAR JOISTS of roof are welded to beams with 2″ fillet welds on each side. First and second floor are reinforced concrete. Final building to be 400 ft. long with 200 ft. wings. Present part is 210 ft. x 63 ft. plus heating plant.

BEAM-TO-COLUMN connections bolted, plumbed, then arc welded. Total steel in present building 160 tons with columns of 5″ to 8″; beams and girders up to 30″. Welded with $\frac{5}{32}$″ and $\frac{3}{16}$″ "Fleetweld 5" electrode and portable Lincoln Welders.

WELDED IN 8 DAYS. Two welders completed the welding of the framework in 5 days after members were erected, and welded the joists to the beams in 3 days. The builder reports that arc welding greatly simplified the erection procedure and resulted in an extremely rigid structure.

NCSBEE Reviews Ramifications of Interstate Registration

(*Continued from page 41*)
marizes the aims of the program as follows:

"1. To make the young engineer more conscious of his obligations as a member of the engineering profession and to acquaint him with the procedure, requirements, and advantages of registration.

"2. To permit him to take the first step toward registration by passing a written examination while subject matter is fresh in his mind.

"3. To assist the young engineer in obtaining immediate professional affiliation, guidance, and protection.

"4. Through increased professional consciousness, better knowledge of the registration procedure, and reduced fear of the final examination, to increase the percentage of young engineers who acquire professional status through registration as soon as they are legally qualified."

The figures of the committee and reports from the floor indicated that large numbers of young graduates are applying for registration in the engineer-in-training classification.

Uniform Qualifications

Obviously it is advantageous to members of the profession to have the requirements for registration reasonably uniform throughout the United States. This aim is partially achieved by the Model Law for the Registration of Professional Engineers, which was first drafted in 1911 and has been brought up to date every few years by the profession. Many of the state laws have been based on one or another of these editions.

Education and experience are elements of qualification. For several years the NSBEE Committee on Qualifications for Registration has made a study of education, examinations, and the kinds of experience desirable for qualification. The general committee is divided into three groups to study oral examinations, written examinations, and experience. Progress reports were made on each of these topics. There is a strong trend toward greater emphasis on college training as a requirement for engineering registration.

Success of Registration

Beginning with Wyoming in 1907, the registration movement has grown until it includes all the states. Forty years were required for all the states to pass laws. Approximately 130,000 persons are now registered by the several boards; probably another 50,000 to 100,000 are eligible for certification. The tasks of the future are to strengthen enforcement and to achieve easier interstate registration.

All the committee reports presented at the meeting, and the discussions and actions taken, will be published in the *Proceedings* of NCSBEE.

The profession as a whole is interested in the problems and procedures of registration, and the technical societies are taking an active part in the work. The meeting was attended by representatatives of the following ten societies:

American Society of Civil Engineers, Walter E. Jessup, Western Representative
American Institute of Mining & Metallurgical Engineers, D. D. Moffat, Director
American Society of Mechanical Engineers, C. E. Davies, Secretary
American Institute of Electrical Engineers, Thomas Jordan, Chairman, Utah Section
American Institute of Chemical Engineers, Dr. E. B. Christiansen
American Society for Engineering Education, Dean Albert L. Taylor
National Society of Professional Engineers, Paul H. Robbins, Executive Director
American Association of Engineers, Charles J. Ullrich
American Society of Agricultural Engineers, S. Milton Henderson
The (Canadian) Dominion Council of Professional Engineers, M. Barry Watson, Secretary-Treasurer

Century of Progress in Lock and Dam Construction

(*Continued from page 31*)
for use with no processing whatever. This practice has gradually changed until now rigid specifications are established for the several types of aggregate, and it is occasionally necessary to bring in "admixtures" to provide certain required graduations which are not available at the source of the bulk of the material.

The introduction of movable or high-lift dams on navigable streams has resulted in several new construction problems. It was always necessary to provide facilities for handling heavy lock gates in the lock chambers of the various structures, although it was generally possible to erect these in place, or in many instances to utilize for the few lifts required the heavy handling equipment available in the district maintenance fleet of the Corps of Engineers. However, on heavy structures such as Gallipolis Dam, it became necessary to "tool up" for the handling of roller-gate parts and engines with equipment capable of lifting up to 40 tons. Special crews of workmen skilled in the assembly of steel and machinery under rigid and difficult conditions and tolerances were brought to the job site to carry on these most important phases of the work. There is little comparison between a job of this nature going full blast and the construction of a fixed or wicket-type dam at the turn of the century.

A New Element—Accident Prevention

A feature of today's construction of locks and dams that was completely absent in the earlier days is the greatly accelerated program for accident prevention. In the "good old days" little constructive thought or effort was directed towards the safety of the individual workman. It is true that he was generally a smart operator who knew how to take care of himself. He followed his employer from job to job and consequently knew his way around on a construction project. Possibly for this reason there did not appear to be too many serious accidents.

With the advent of a generally revised policy in labor matters, it became the exception rather than the rule for the marine construction worker to move from job to job with his employer, except for key men and foremen. Consequently on each job a new work force was hired and broken in. Accidents increased and the insurance burden of individual contractors became intolerable. The construction industry as a whole took several years to wake up to the need for mending its fences, but having done so it has greatly improved the accident record in recent years.

East Meets West in Control of China's Yellow River

Continued from page 39)
river for many years and have its "feel," will be an undertaking extremely popular among all Chinese. This is not a task for amateurs in China nor for politicians from Nanking or elsewhere. All the skill based on long experience that can be summoned should be used in working out final plans. With unrelaxing maintenance, the present works can take a river discharge of 600,000 cfs or more. A discharge of at least 1,000,000 cfs should be envisaged in the new comprehensive plan. Western equipment then will play a part, but Chinese muscle and local tools and materials will be heavily drawn upon in the execution of the work.

Brackish Water Not Harmful in Concrete Mix, Study Shows

(*Continued from page 35*)

number of large cracks and spalling evidenced; (*d*) steel reinforcing exposed by digging found to be slightly rusted; (*e*) no information as to date placed or characteristics of mix; (*f*) curing conditions: average temperature 78 deg F, average rainfall per month 3.32 in., relative humidity 78 percent.

There are a number of other concrete structures which were placed by the Sixty-fifth Seabees. This concrete was made with fresh water and is still in good condition. These structures were not examined.

Naval Operating Base, Saipan. Unable to determine if any such concrete was ever placed on Saipan. There are several examples of Japanese concrete construction and such structures as were examined are in good condition. We assumed the Japs used fresh water since there is a plentiful supply.

Naval Air Station, Johnston Island. Existing concrete structures on Johnston Island and Sand Island are as follows: Recreation halls: (*a*) Present condition of concrete is poor; (*b*) surface is deteriorating; (*c*) concrete crumbling in spots and is very powdery when chipped; (*d*) reinforcing steel slightly rusted; (*e*) no information as to date placed or characteristics of mix; (*f*) same as above. Concrete still around base of Quonsets for typhoon protection: (*a*) Condition of concrete is fair; (*b*) slight signs of deterioration; (*c*) minor cracks and spalling quite evident; (*d*) reinforcing steel slightly rusted; (*e*) no information as to characteristics of mix, date placed June 1946.

Concrete made here with brackish water is not good. It cracks and spalls easily and crumbles very easily under impact. The condition of steel reinforcing does not give an indication of the action of brackish water on steel, as I believe that bars were placed with a coat of rust on them. Though not according to best practice, this condition is extremely difficult to avoid in a climate like Wake's.

To place clean, non-rusted bars would have entailed extensive sandblasting with increased time of completion of the job.

There were also inspected: Airplane warm-up area, 6 in. thick, 26,000 sq ft; two underground hospitals, 8,675 sq ft; one underground dispensary, 640 sq ft; one surface shop, 1,024 sq ft; five surface utility buildings, 3,194 sq ft; officers club, 6-in. floor slab, 3,390 sq ft; several 90-mm gun emplacements, and underground communication structure.

From information available, the above structures were built late in 1941, 1942, and 1943, with the exception of the officers' club, which was built in 1945. Inspection revealed them to be in excellent condition with practically no deterioration of the surfaces, including those exposed to the weather. Very little cracking, crumbling or spalling was apparent but the usual hairline cracks were observed. In one communication dugout there was a rupture 1/2 in. in width and 5 ft in length exposing reinforcing steel bars, caused from faulty design and not the concrete. Reinforcing steel was exposed by drilling into the walls. The steel showed a small amount of rusting, but the concrete was not stained. The water-cement ratio and method of curing are not known.

Yearly average temperature, 8[illegible] deg F; daily variation of temperature, 8 to 10 deg; yearly rainfall, 1[illegible] to 20 in.; and relative humidity, 7[illegible] percent.

A study of the foregoing comments indicates: (*a*) That brackish water of low-degree salinity (57 grains NaCl per gal as compared to 1,63[illegible] grains of ordinary sea water) has no apparent adverse effect on the concrete compressive strength when employed in the mix; (*b*) that the amount of brackish water used in concrete mixes at Midway, Johnston, and Wake probably had its saline properties considerably reduced by the large moisture content of the aggregate; (*c*) that use of brackish water does not result in any appreciable increase in corrosion of reinforcing steel; (*d*) that cracking and spalling are not a direct result of the use of brackish water; (*e*) that curing concrete fabricated with brackish mixing water, at an average relative humidity of 75 to 80 percent and at an average temperature of 80 deg F, apparently is no guarantee that cracking or spalling will be prevented.

ELECTRIC POWER STATIONS, Volume I. By T. H. Carr, with a foreword by Sir L. Pearce. 3 ed. rev. & enl. Chapman & Hall, Ltd., London, 1947. 513 pp., illus., diagrs., charts, tables, 8 3/4 × 5 1/2 in., cloth, 36*s*. The opening chapters deal briefly with the fundamentals of station design and construction. Succeeding chapters give detailed information on the following major topics: circulating water systems; cooling towers; coal-handling plant; ash-handling plant; pipework; turbines; and a large section covering the boiler plant. A bibliography accompanies each chapter.

ELEMENTS OF PHOTOGRAMMETRY. By Earl Church, Assoc. M. ASCE, and Alfred O. Quinn. Syracuse University Press, Syracuse, N.Y., 1948. 120 pp., illus., charts, diagrs., tables, 9 1/4 × 6 in., cloth, $3. This revised and expanded edition of Mr. Church's *Elements of Aerial Photogrammetry*, published in 1944, has been prepared to serve as a textbook for an introductory course in elementary photogrammetry. It presents the history and background of the subject, together with the basic principles and fundamental applications now possible in this field. No attempt has been made to discuss advanced phases of the subject or the many special applications of the science. The book is divided into two parts, the first devoted to fundamental principles and to description of field and office procedures. Part II contains data on practical mapping methods which are essential to an initial knowledge of the subject.

HEAT CONDUCTION WITH ENGINEERING AND GEOLOGICAL APPLICATIONS. By L. R. Ingersoll, O. J. Zobel and A. C. Ingersoll. McGraw-Hill Book Co., New York, Toronto, London, 1948. 278 pp., diagrs., charts, tables, 9 1/4 × 6 in., cloth, $4. Based on the earlier text, *Theory of Heat Conduction*, the present volume retains much of the old material, thoroughly revised, and provides new data. It contains many practical applications for the geologist and engineer, including such subjects as ground heat-pump sources, geysers, periodic flow, electric welding, and canning and drying operations. An outstanding feature is the chapter on graphical and other methods by which a large variety of heat-conduction problems may be solved with only the simplest mathematics.

HEATING, VENTILATING, AIR CONDITIONING GUIDE 1948, 26 ed. American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York, 1948. 1,280 pp., plus Roll of Membership, 144 pp., illus., diagrs., charts, maps, tables, 9 1/4 × 6 in., fabrikoid, $7.50. This standard manual constitutes both a textbook and handbook on the design and specification of heating, ventilating and air conditioning systems. The technical data section has been substantially revised to include present knowledge and engineering practice. A new chapter on corrosion and water-formed deposits, their cause and prevention, has been added. In the catalog section 230 manufacturers are represented. A convenient cross-index provides access to the more than 900 pages of technical information.

POWER AND PROCESS STEAM ENGINEERING. By D. Copp. Longmans, Green and Co., New York, Edward Arnold & Co., London, 1947. 173 pp., illus., diagrs., charts, tables, 8 3/4 × 5 1/2 in., cloth, $3.75. Of value to those interested in the efficient use of industrial fuel, this practical book presents the methods and principles of combined heat and power-producing installations. It emphasizes the fullest use of the latent heat of steam and describes systems which derive the most energy from fuel. Many charts and diagrams illustrate the text.

POWER FROM THE WIND. By P. C. Putnam. D. Van Nostrand Co., Toronto, New York, and London, 1948. 224 pp., illus., diagrs., charts, maps, tables, 9 1/2 × 6 in., cloth, $6. Of interest to those investigating new sources of power this is the record of the wind-turbine experiment conducted in Vermont by a group of eminent scientists and engineers. The purpose of the work was to find out the possibilities of generating electricity on a large scale by harnessing the wind. The book summarizes the various technical problems encountered, the attempts at solving them, and the findings and discoveries made.

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October 1, 1948 — Number 10

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every Member is urged, therefore, to scan carefully the list of candidates published each month in Civil Engineering *and to furnish the Board with data which may aid it in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who kn applicant personally as well as upon the nature and extent of hi fessional experience. Any facts derogatory to the personal chara professional reputation of an applicant should be promptly com cated to the Board. Communications relating to applicants ar sidered strictly confid

The Board of Dir will not consider the cations herein containe residents of North A until the expiration days, and from non-re of North America un expiration of 90 days the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

Grade	General Requirement	Age	Length of Active Practice	Responsible Charge of Work
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years
Associate Member	Qualified to direct work	27 years	8 years	1 year
Junior	Qualified for subprofessional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years

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Fox, Jeff Stanley (Assoc. M.) (Age 47) Airways Engr., Civil Aeronautics Administration, Fort Worth, Tex.

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Lamberti, Blas Alberto (Age 27) As Prof., Universidad Central de Venezuela, Ca Venezuela.

Latif, Abdul (Age 33) Executive Asst. Personal Asst. to Chf. Engr., Irrigation Decca, Eastern Palestine.

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(Continued on page 76)

(Continued from page 74)

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Christenson, Kenneth Dyril, 1948	(25)
Currie, Robert Stanley, 1948	(26)
Finrow, Douglas Wayne, 1948	(25)
Heckard, John Albert, 1948	(24)
Johannesen, Allen Julius, 1948	(28)
Kjelstad, Nels Oliver, 1948	(22)
Kuhn, Carl Hans, 1948	(21)
Law, Dick Wee, 1948	(27)
Lawson, Robert Taylor, 1948	(22)

	Age
Olsen, Carl Stanford, 1948	(22)
Perrins, Robert, 1948	(29)
Petteys, John Archibald, Jr., 1948	(25)
Rowse, Robert Roy, 1948	(23)
Smith, William Durkee, Jr., 1948	(30)
Straith, William Jack, 1948	(26)
Young, Dale Robert, 1948	(25)
Young, Loren Emitt, 1948	(26)

UNIV. OF WIS.

Haggerty, John Richard, 1948	(22)

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Adams, Richard Sterling, 1948
Anderson, Joe Meeks, 1948
Benes, Irvin J., 1948
Brown, Ross Parkinson, 1948
Erzen, Ben Thomas, Jr., 1948
Kilgore, John Robert, 1948
Rivkin, Leonard, 1948

The Board of Direction will consider the appli- tions in this list not less than thirty days after the d of issue.

CHANGES IN MEMBERSHIP GRADES

ADDITIONS, TRANSFERS, REINSTATEMENTS, AND RESIGNATIONS

From August 10 to September 9, 1948

Additions to Membership

Atkins, William Raymond (Assoc. M. '48) Dist. Engr., South African Rlys. & Harbours, Care, Chf. Civ. Engr., S. A. Rlys. Headquarters (Res., 17 Bristol Rd., Parkwood), Johannesburg, South Africa.

Balmer, Harry Arnold (Jun. '48) Civ. Engr., Dept. of Interior, Bureau of Reclamation, Room 7637, South Interior Bldg. (Res., 76 Forrester St., S.W., Apt. 303), Washington, D. C.

Barksdale, William Albie (Jun. '48) (Res., 1706 Bruce Ave., Charlottesville, Va.)

Bartel, Herbert Herman, Jr. (Jun. '48) Instr. Civ. Eng., School of Eng., Southern Methodist Univ., Dallas 5, Tex.

Bender, John Andrew (Jun. '48) Junior Engr., Davison Chemical Co., Box 471 (Res., Box 81), Bartow, Fla.

Bender, William Henry (Jun. '48) Student (Graduate) State Agr. & Mech. College, Civ. Eng. Dept. (Res., P.O. Box 4658), College Station, Tex.

Bennett, John Forster (Assoc. M. '48) Civ. Engr., Gulf Oil Corp., P.O. Drawer 2100, Houston, Tex.

Besse, Carl Theodore (Jun. '48) Civ. Engr., P-3, United States Bureau of Reclamation, Denver Federal Center (Res., 1540 Marion St.), Denver, Colo.

Biddinger, Charles, Jr. (Jun. '48) Field Engr., Ebasco Services, Inc., Care, State Power & Light Co. (Res., 2703 Columbus Ave.), Waco, Tex.

Bishop, Ronald Willsie (Assoc. M. '48) Civ. Engr., P-3, Puget Sound Naval Shipyard, Bldg. 78 (Res., 643 Washington Ave.), Bremerton, Wash.

Bisht, Madhab Singh (M. '48) Chf. Engr., Public Work Dept., Lucknow, India.

Blench, Thomas (M. '48) Care, Lloyds Bank Ltd., 72 Lombard St., London, E.C. 3, England.

Bohne, Lester William (Jun. '48) Office Engr., United Engrs. & Contrs., Inc., P.O. Box 300, Gary, Ind. (Res., Box 282, R.R. 1, Worth, Ill.)

Boise, Charles Lucas (Jun. '48) Senior Instrumentman, State Highway Dept., Dist. 24 (Res., 3906 Porter), El Paso, Tex.

Bowles, Reginald Ewart (M. '48) Manchester Education Committee, College of Technology, Manchester (Res., Denmere, Telegraph Rd., Heswall, Cheshire), England.

Brunner, Kenneth (Jun. '48) Junior Civ. Engr., State Div. of Highways, Dist. VII, Design Section, 206 South Spring St. (Res., 254 South Carondelet), Los Angeles, Calif.

Buckley, James Molony (Jun. '48) Field Engr., Stone & Webster Eng. Corp., Bldg. 273 Annex, General Electric Co. (Res., 816 State St.), Schenectady, N.Y.

Burlingame, Roland Smith (Assoc. M. '48) Principal Asst. Engr., Camp, Dresser & McKee, 6 Beacon St., Boston, Mass.

Butler, Jerome Joseph (Jun. '48) Asst. Instr., Civ. Eng. Dept., Marquette Univ., 1515 West Wisconsin Ave., Milwaukee, Wis.

Camarca, Thomas Chiro (Jun. '48) Civ. Eng. Asst., City of Los Angeles, Room 708, City Hall (Res., 158 West 64th St.), Los Angeles, Calif.

Christ, Roy Henry (Jun. '48) Field (piping) Engr., Refinery Constr., The Lummus Co., P.O. Box 6462, Point Breeze Station, Philadelphia (Res., Apt. A207, Stonehurst Courts Apts., Upper Darby), Pa.

Cordell, Ben Early, Jr. (Jun. '48) Insp., State Fire Prevention & Eng. Bureau, 300 First National Bank Bldg., Dallas, Tex.

Cottingham, Ralph Oliver (Assoc. M. '48) City Engr., City of Greeley, P.O. Box 1014, Greeley, Colo.

Cousins, Edward Arthur, Jr. (Jun. '48) Constr. Supt., Cousins Home Builders, 1913 North 77th Ave. (Res., 4041 West Mapole Ave.), Chicago, Ill.

Cox, William Ray, Jr. (Jun. '48) Junior Engr., Shell Oil Co., Inc., Houston (Res., Box 488, Denver City), Tex.

Curry, John Joseph (Assoc. M. '48) Senior San. Engr., State Water Comm., State Office Bldg., Hartford (Res., 62 West Main St., Milford), Conn.

Danek, George Duane (Jun. '48) Junior Engr., City of Racine, City Hall (Res., 3315 Kinzie Ave.) Racine, Wis.

Daniel, Louis Scott (Assoc. M. '48) Asst. Prof., Univ. of Hawaii, Honolulu, Hawaii.

De Carolis, Fred (Assoc. M. '48) Asst. Civ. Engr., Triborough Bridge & Tunnel Authority, 10 State St., New York (Res., 4220 Kissena Blvd., Flushing), N.Y.

Deemer, Harry O'Neil (Assoc. M. '48) Chf. Engr. Nellis Constr. Co., 656 St. Clair Ave., East Liverpool, Ohio. (Res., Box 177A, R.D. 9, Pittsburgh, Pa.)

Deep, Farris Anthony (Jun. '48) Instrumentman, Louisville & Nashville R.R., 301 Union Station, Nashville, Tenn.

Desimone, Salvatore Vincent (Jun. '48) Junior Engr., Moran, Proctor, Freeman & Mueser, 420 Lexington Ave. (Res., 3221 Oxford Ave.), New York, N.Y.

Dick, Clifford Leray (Assoc. M. '48) Civ. Engr., Aluminum Co. of America, Hydr. Dept., 1524 Oliver Bldg., Pittsburgh (Res., Prospect), Pa.

Doane, Royal Belden (M. '48) Asst. Highway Engr., State Dept. of Highways, 165 Capitol Ave., Hartford (Res., 43 Federick St., Newington), Conn.

Dumler, Fred (Jun. '48) Civ. Engr. (Sales), Armco Drainage & Metal Prod., 3033 Blake St., Denver, Colo.

Eding, Lawrence Henry (Jun. '48) Lt. (j.g.) CEC, U.S. Navy, N.A.S. Kaneohe Bay, Oahu, Territory Hawaii. (Res., 726 Rosewood Drive. Palo Alto, Calif.)

Eldrige, Edward Franklin (M. '48) Chf. Engr., Pollution Control Comm., Olympia, Wash.

Epstein, Oscar (Jun. '48) Structural Draftsman, Stone & Webster Eng. Corp., 49 Federal St., Boston (Res., 23 Ferndale St., Dorchester), Mass.

Evans, Daniel Lester (M. '48) Cons. Engr. (Res., 4323 East 44th St., Seattle, Wash.)

Fahey, William Vernon (Assoc. M. '48) Civ. Engr. (Res., 4250 North Girard Ave., Minneapolis, Minn.)

Forgues, Robert (Jun. '48) Field Engr., New Jersey Zinc Co. (Res., Horse Head Inn), Palmerton, Pa.

Friedland, Lawrence (Assoc. M. '48) Asst. Civ. Engr., Board of Water Supply, 120 Wall St., New York (Res., Pine Bush), N.Y.

Galbreath, Robert Henry, Jr. (Jun. '48) Graduate Work at Carnegie Inst. of Technology, Schenley Park, Pittsburgh, Pa. (Res., 7625 Third Ave. South, Birmingham, Ala.)

Galloway, David Edgar (Jun. '48) Civ. Engr., Humble Oil & Refining Co., P.O. Box 672, Kingsville, Tex.

Garfink, Malcolm Ofterro (Jun. '48) Con Engr., Standard Constr. Co., Queenstown (Re Apt. 101, 3252 Thirty-third Ave.), Mt. Rain Md.

Geiger, Sydney, Jr. (Jun. '48) Draftsman in D sign Dept., Virginia Bridge Co. (Res., Apt. B 2310 Highland Ave.), Birmingham, Ala.

Geuder, Norman Oliver (Jun. '48) Instrume man, Chicago, Milwaukee, St. Paul and Paci R.R. Co., 2599 Grand Ave., Chicago (Res., 3 Wisconsin Ave., Berwyn), Ill.

Goodwin, Charles Alfred (Jun. '48) Tra Engr., Liberty Mutual Ins. Co., 175 Berke St., Boston (Res., 263 Essex Ave., Glouceste Mass.

Graves, Charles Bryant, Jr. (Jun. '48) Gradu Student & Asst., Georgia Inst. of Technolo Atlanta, Ga. (Res., 1398 Coleman Ave., Wh mire, S.C.)

Gullett, Ralph Andrew (Assoc. M. '48) C Engr., P-5, Bureau of Reclamation, Den Federal Center, Bldg. 1A (Res., 1520 Glenco S Denver, Colo.

Hammond, George Rolland (M. '48) Vice-Pr General Eng. Co., Inc., 725 Central Bld Seattle, Wash.

Heimerich, John James (Assoc. M. '48) As Prof., Head, Dept. of Architectural Eng., Univ. New Mexico, Albuquerque, N.Mex.

Hennelly, Edmund Paul (Jun. '47) Instr. C Eng. Dept., Manhattan College, 242d St. a Spuyten Duyvil Parkway, New York (Re 139-60 Two Hundred Thirty-second St., Laur ton L.I.), N.Y.

Henson, Henry Lyle (M. '48) Chf. Engr., Peerl Cement Corp., 1144 Free Press Bldg., Detr (Res., 1731 Beaver, Dearborn), Mich.

Herr, Lester Abram (Jun. '48) Instr., Dept. Mechanics, Ohio State Univ., I.E. Bldg. (Re 1539 1/2 North High St.), Columbus, Ohio.

Herrin, Moreland (Jun. '48) Instr., Oklaho Agr. & Mech. College, Civ. Eng. Dept. (Re Box 158, Veterans Village), Stillwater, Okla.

Hiner, Charles William (Assoc. M. '48) Di Engr., Portland Cement Assn., 504 South 1 St., Omaha, Nebr.

Hodge, Martin Richard (Jun. '48) Senior E Aide, N.Y. State Dept. of Public Works, Div. Highways, 444 Van Duzee St., Watetown (Re 101 West Main St., Sacket Harbor), N.Y.

Hodge, Raymond Joseph (Jun. '48) Resea Associate, Cornell Univ., Civ. Eng. Scho Ithaca, N.Y.

Hodgkiss, Arthur Salisbury (M. '48) Executi Officer, Dept. of Parks, Arsenal Bldg., 64th S and 5th Ave., New York, N.Y.

Horewicz, Juliusz (Jun. '48) Civ. Engr., Colum Univ., Broadway and West 116th St. (Res., 3 Riverside Drive), New York, N.Y.

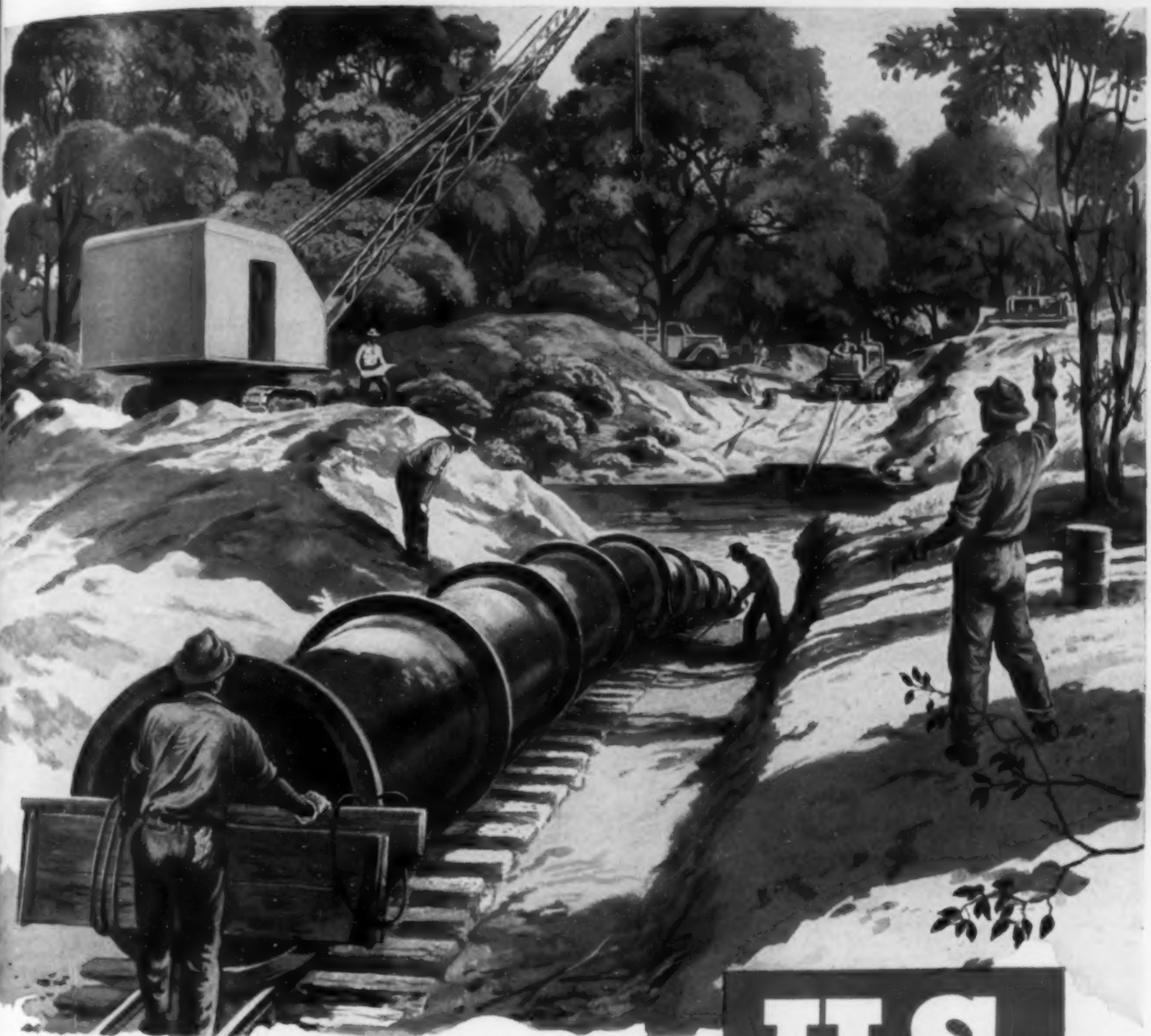
Houtman, John Edward (Jun. '48) Junior C Engr., G. D. Houtman, 112 West Front S Media, Pa.

Hudson, William Dillenback (Assoc. M. ' Field Engr., The Pitometer Co., 50 Church S New York, N.Y.

Huffmire, Wynant Stanley (M. '48) Asst. C Engr., State Board of Water Supply, Neversi N.Y.

Hung, David Shen (M. '48) Deputy Direct Dept. of Railways, Ministry of Communicatio Nanking, China.

(Continued on page 80)



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(Continued from page 78)

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Malicopoulos, Stephanos (Assoc. M. '48) Planning Engr., Hydr. Works Section, Dept. of Public Works, Woulis St. 31 (Res., Tritis Septembriou St. 48), Athens, Greece.

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Murdock, John Washburn (Jun. '48) Ensign (Asst. Civ. Engr.), Civ. Engr. Corps, U.S. Navy, Room 234, Port Hueneme, Calif. (Res., 420 South Center, Terre Haute, Ind.)

Nivas, Hari Krishna (M. '48) (I.S.E.) Deputy Chf. Engr., Public Works Dept., Patna Bihar, India.

O'Brien, Daniel William (Jun. '48) Office Engr., Friant-Kern Project, Morrison Knudesen Co., Inc., & M. H. Hasler, P.O. Box 92 (Res., 820 Mildreda Ave.), Fresno, Calif.

Omari, Shakib Muhammad (Jun. '48) Civ. Engr., Ministry of Public Works, (Res., Nouri Pasha St., Salhia), Damascus, Syria.

Packard, Milan Owen, Jr. (M. '48) Pres., Packard Contr. Co., 601 Luhrs Tower Bldg., Phoenix, Ariz.

Palmer, Stanley Canada (Assoc. M. '48) Asst. City Engr., City of Kansas City, 19th Floor, City Hall, Kansas City, Mo.

Paton, Thomas Angus Lyall (M. '48) (Sir Alexander Gibb & Partners), Queen Anne's Lodge, Westminster, London, S.W. 1 (Res., Hillside Garth, Givons Grove, Leatherhead, Surrey), England.

Peters, Edward Russell (Assoc. M. '48) Asst. Editor, McGraw-Hill Publishing Co., 330 West 42nd St., New York 18, N.Y.

Peters, Iredell W. (Assoc. M. '48) Sales Engr., The Tenn. Metal Culvert Co., 923 Cooper St., Knoxville, Tenn.

Petersen, Donald Carl (Jun. '48) Engr. in Training, Stanley Eng. Co., Muscatine, Iowa.

Phillipy, Lester Newton (M. '48) Vice-Pres., The Whiting-Turner Cont. Co., 305 National Marine Bank (Res., 845 East Belvedere Ave.), Baltimore, Md.

Pizzotti, John Leo (Assoc. M. '48) Senior Asst. Subway Engr., Dept. of Subway & Super Highways, 501 South Plymouth Court (Res., 357 East 117th St.), Chicago, Ill.

Pollock, Virgil Henry (Assoc. M. '48) Civ. Engr., J.C. Nichols Co., 310 Ward Parkway (Res., 4001 Locust), Kansas City, Mo.

Powell, Earl Lehr, Jr. (Jun. '48) Box 850, Route 10, Tacoma, Wash.

Pugh, William Hartley (Assoc. M. '48) Civ. Engr., Vogt, Ivers, Seaman & Associates, 509 Second National Bank Bldg., Cincinnati, Ohio.

Raining, Charles Richard (Jun. '48) Asst. Dist. Engr., Johns-Manville, 1000 Market St., St. Louis (Res., 9370 Old Bonhomme Rd., Clayton), Mo.

Randall, Edmund Louis (M. '48) Senior Field Engr., Shell Oil Co., Inc., Martinez Refinery, P.O. Box 711, Martinez, Calif.

Reeve, John James (Jun. '48) Lt. (j.g.), CEC, U.S. Navy, CECOS, Port Hueneme, Calif.

Reid, Carl Robert (M. '48) Engr. of Training, State Dept. of Highways, Capitol Office Bldg. (Res., 440 North West 22d St.), Oklahoma City, Okla.

Reid, George Willard (Assoc. M. '48) Assoc. Prof. of San. Eng., Civ. Engr., Georgia School of Technology, Atlanta, Ga.

Register, Richard Herbert (Jun. '48) Junior Civ. Engr., Hetch Hetchy Water Supply, 425 Mason St., San Francisco (Res., 751 South 52d St., Apt. 1-B, Richmond), Calif.

Reidy, Roger Patrick (Jun. '48) Structural Draftsman & Designer, Maurice A. Reidy, Engr., 101 Tremont St., Boston (Res., 45 Chester St., Newton Highlands), Mass.

Rockenbach, Philip John (Jun. '48) Junior Field Engr., General Electric Co., Richland (Res., Route 1, Box 5, Benton City), Wash.

Rustigan, Ralph Bapist (Jun. '48) Junior Engr., San Francisco Public Utilities, 425 Mason St., San Francisco (Res., 1290 Echo Ave., Fresno), Calif.

Sandlin, Ellis Fred (Jun. '48) Civ. Engr., State Highway Dept., 1127 Rincon Court, Tucson, Ariz.

Schoettler, James Lewis (Assoc. M. '48) Div. Maintenance Engr., Public Roads Administration, 1109 Post Office (Res., 1760 Scheffer Ave.), St. Paul, Mich.

Seshavathram, Chega (M. '48) Engr., Public Works Dept., Govt. of Madras, Madras, India. (Res., Care, Embassy of India, 2107 Massachusetts Ave. N.W., Washington, D.C.)

Settle, William Charles (Jun. '48) Chf. of Highway Location Party, F. C. Settle, Civ. Engrs., 20 Court St. (Res., 116 South Adair), Pryor, Okla.

Skogstad, Tor (Jun. '48) Structural Engr., Sverdrup & Parcel, Inc., Syndicate Trust Bldg. (Res., 5956 Clemens Ave.), St. Louis, Mo.

Slack, Lewis Cecil (Jun. '48) Civ. Engr., P-2, Corps of Engrs., P.O. Box 1538, Albuquerque, N.Mex.

Smith, Joseph Curtis (Assoc. M. '48) Res. Engr., Donald R. Warren Co., 3036-A Adeline St., Berkeley (Res., 5033 Pierpoint Ave., Oakland), Calif.

Smith, Lowell Michael (Jun. '48) Civ. Engr. I, City of Milwaukee Street Constr. (Res., South 71st St.), Milwaukee, Wis.

Stearns, Whitney Kneeland (Jun. '48) Engr., U.S. Pipe & Foundry Co., 71 Broad New York, N.Y.

Stepanek, Gordon John (Jun. '48) Junior E Chicago Bridge & Iron Co., 1305 West 105th Chicago (Res., 1643 South 58th Ave., Cicero)

Stone, Dean Putnam (Jun. '48) Engr., Clinc Fortier Inc., 1526 Wallace Ave., San Fran (Res., 416 Fairfax Ave., San Mateo), Calif.

Stratton, Charles Herbert (Jun. '48) De man & Design, A. L. Jackson Co., Inc., Buil Niagara Falls (Res., 33 East Ave., Newf N.Y.

Sumner, Lawton Taylor (Assoc. M. '48) Engr., Fisher Lime & Cement Co., 269 W St., Memphis, Tenn.

Swanson, Herbert Sixtus (Assoc. M. '48) J Structural Engr. "B," Dept. of Water & P 207 South Broadway (Res., 3230 Garden Los Angeles, Calif.

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Thomas, Lawrence Randall (Jun. '48) J Engr., Virginia Bridge Co., P.O. Box 116, Bir ham, Ala.

Tilden, George Frederick Weitzel (Assoc '48) Structural Engr., Kansas City Struc Steel Co., 21st and Metroplitan (Res., 3718 Ave.), Kansas City, Kans.

Tonelli, Dan, Jr. (Jun. '48) Junior Civ. E Div. of Highways, 1204 Chanslor Ave., mond, Calif.

Turner, Brinton Ellsworth (Jun. '48) Job E Peter Kiewet Sons Co., Kieways Ave., Ar (Res., 1201 Bay St., Apt. B., Santa Mo Calif.

Vaughn, Edward Leslie, Jr. (Jun. '48) E Frank N. Kneas (Res., 5043 Cottage St., Phi phia, Pa.)

Viets, Warren Randall (Jun. '48) Photo metrist, United States Geological Survey, S mento (Res., Route 7, Box 1149, North S mento), Calif.

Virtue, Ralph Theorn (Jun. '48) Drafts Rather, Moore & Associates, 1640 Missouri (Res., 5235 Leeland Ave.), Houston, Tex.

Warren, John Armstrong (Jun. '48) Engr., Goodwin Eng. Co., 726 South 29th St., Bir ham Ala.

White, John Franklin (Jun. '48) Capt., Cor Engrs., U.S. Army, Engr. Section 2nd Army, Meade, Md.

Willis, Ellsworth Barnett (M. '48) Se Engr., Board of Water Supply, Lackawack 115 Lincoln Pl., Liberty), N.Y.

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Wright, Henry (Jun. '48) Junior Civ. Engr., Div. of Highways, Div. of Highways Bldg. & Spring St. (Res., 2715 Portland St.), Angeles, Calif.

Ziemke, Donald Paul (Jun. '48) Drain E County Drain Comm., Lafayette at Sag (Res., 25 Lorraine Court), Pontiac, Mich.

Zimmerman, John Kenneth (Jun. '48) Det Nelson Eng. Sales, Inc., 226 J.M.S. Bldg., S Bend (Res., 807 West Lawrence St., Mishaw Ind.

Ziner, Erwin Norbert (Jun. '48) Asst. E Volpe Constr. Co., 54 Eastern Ave., M (Res., 165 Hemenway St., Boston), Mass.

Membership Transfers

Bayles, Charles Clifford (Jun. '36; Asso '47) Cons. Engr. (Res., 2021 Riverview Eugene, Ore.)

Benjamin, Jack Ralph (Jun. '40; Assoc. M. Asst. Prof., Civ. Eng. Dept., Stanford U Stanford, Calif.

Book, Joseph Emanuel (Jun. '40; Assoc. M. 4406 Wentworth Rd., Baltimore 7, Md.

Buford, Charles Homer (Assoc. M. '17; M. President, Chicago, Milwaukee, St. Paul & P R.R., 874 Union Station, Chicago (Res., Ridge Ave., Evanston), Ill.

Cartier, Leonard (Jun. '43; Assoc M. '48) A Prof. of Hydrs., Ecole Polytechnique (De treal), 1430 Saint Denis St., Montreal 18, Ca

Castella, William Floyd (Jun. '41; Asso '45; M. '48) Design Engr., J. V. Curnutte, Engr., 1615 Transit Tower, San Antonio, T

(Continued on page 84)

(*Continued from page 82*)

desirable. Salaries open. Location, Colombia. Y-1444.

DEAN OF SCHOOLS OF TECHNOLOGY, 35–45, civil, mechanical, electrical or industrial graduate, with 5 to 10 years' engineering, supervisory or teaching experience. Aptitude for technical writing, arranging curricula, and doing administrative work for correspondence school. Salary open. Location, East. Y-1452.

CIVIL ENGINEER familiar with indeterminate structures and 10 years' experience with a consulting engineer or a structural steel company. Additional experience on actual construction work desirable, for preparation of design and construction drawings for highway bridges. Salary, \$5,400–\$7,200 a year. Location, Pennsylvania. Y-1453.

CONSTRUCTION SUPERINTENDENT, 40–50, with at least 10 years' industrial plant experience for chemical project. Salary, \$8,000–\$10,000 a year. Location, West Virginia. Y-1460.

CIVIL ENGINEER, with at least 15 years' experience in connection with dam design and construction, of which at least 5 to 10 years should have been in responsible charge of work, for the development of irrigation, flood control, drainage and power projects. Salary, \$18,000 a year. Location, Venezuela. Y-1468-D-S.

DEAN OF ENGINEERING, civil graduate, with doctor's degree and at least 10 years' professional experience, including heavy construction, hydraulics, irrigation, etc., to assume complete executive responsibility of engineering school. Salary, \$6,000–\$7,500 a year. Location, West. Y-1498-S.

MUNICIPAL ENGINEER to take charge of the design and supervision of construction of a sewer and water distribution system and street pavement program. Salary, \$7,200 a year. Location, Hawaii. Y-1519.

DESIGN AND LAYOUT DRAFTSMEN, civil or aeronautical engineers, graduates, with experience in transport or cargo planes, to design a[nd] lay out aircraft structures and accom[...] Salary, \$3,900–\$5,200 a year. Location, Wa[sh]ington, D.C. Y-1521.

DISTRICT SANITARY ENGINEER, 25–35, [...] graduate with major in sanitary or public hea[...] engineering, with some experience, to review p[...] grams, methods and installations and ma[...] recommendations regarding the efficiency of [...] sanitary facilities in two or three districts. [...] view all sanitation equipment and programs su[...] as water treatment plants, sewerage treatme[...] plants, refuse disposal operations, etc. M[...] learn Spanish. Salary, \$5,400–\$6,300 a ye[...] Location, Venezuela. Y-1525.

SUPERINTENDENT OF PUBLIC WORKS, c[...] graduate with municipal experience, to ta[...] charge of streets, buildings, water supply a[...] sewage disposal systems. Write stating exp[...] ence, education, etc. Location, northern N[...] England. Y-1540.

(*Continued from page 80*)

CROOK, STANLEY FRANKLIN (Jun. '37; Assoc. M. '48) Structural Engr. and Purchasing Agent, The Austin Co., P.O. Box 440 (Res., 206 East Williams St.), Midland, Mich.

DAILY, EUGENE JOSEPH (Jun. '36; Assoc. M. '48) Asst. Prof. of Civ. Eng., Univ. of Ill., 201 Eng. Hall, Urbana, Ill.

DALY, EDMUND SHAFTESBURY (Jun. '39; Assoc. M. '48) Area Engr., Hydr. Data Branch, Tennessee Valley Authority, P.O. Box 906, Elizabethton, Tenn.

DAVIDSON, HEBERT (Assoc. M. '38; M. '48) Associate Engr., Hardesty & Hanover, 101 Park Ave., New York, N.Y.

D'ERRICO, THOMAS RICHARD (Jun. '42; Assoc. M. '48) Instr., Clarkson College of Technology, Potsdam, N.Y.

DVORAK, JOHN JERRY (Jun. '35; Assoc. M. '48) Chf. Draftsman, Humble Oil & Refining Co., Baytown Refinery, Baytown (Res., 6125 Washington Ave., Houston), Tex.

ELDEN, WILLIAM ROBERT (Jun. '37; Assoc. M. '48) Civ. Engr., Roy W. Christy Constr. Co., Box 828 (Res., 1075 West Prairie), Decatur, Ill.

FOWLKES, BENJAMIN COBB, JR. (Assoc. M. '37; M. '48) Col., Corps of Engrs., U.S. Army, Fort McNair, Washington, D.C.

FROST, GEORGE WALKER (Jun. '35; Assoc. M. '48) Supt., Turner Constr. Co., 420 Lexington Ave., New York, N.Y. (Res., 1241 Maple Ave., Wilmette, Ill.)

GOLDSWORTHY, FRED MICKELWAIT (Jun. '36; Assoc. M. '48) Engr., C. F. Griggs, Cons. Engr., 819 Paulsen Bldg. (Res., 503 West 17th Ave.), Spokane, Wash.

HACKETT, PERRY BRADBURY (Jun. '36; Assoc. M. '48) Maj. USA, Corps of Engrs., U.S. Army, Box 495 (Res., 409 Washington St.), Stillwater, Okla.

HARTSFIELD, MARVIN FURR (Jun. '38; Assoc. M. '48) Estimator, Guy F. Atkinson Co. & J. A. Jones Constr. Co., P.O. Box 742, Richland (Res., Gen. Delivery, North Richland), Wash.

JOHANSEN, HENDRYX WOODROW (Jun. '44; Assoc. M. '48) Assoc. Prof. of Civ. Eng., Univ. of Alaska, Box 191, College, Alaska.

LANE, JOHN ELLISON (Assoc. M. '41; M. '48) Vice-Pres., Shore View Developers, Inc., 23-37 Cass Pl. (Res., 1214 East 10th St.), Brooklyn, N.Y.

LAYSON, JOHN DON (Jun. '44; Assoc. M. '48) San. Engr., Eng. Dept., City of Stockton, City Hall (Res., 1710 North Eldorado St.), Stockton, Calif.

LIPSON, SAMUEL LLOYD (Jun. '37; Assoc. M. '48) Assoc. Prof., Dept. of Civ. Eng., Univ. of British Columbia (Res., 1135 West 14th Ave.), Vancouver, B.C.

LUDIN, MOHAMMAD KABIR (Assoc. M. '43; M. '48) Minister of Public Works, Ministry of Public Works, Darulfunoon (Res., Shahr-i-Naw), Kabul, Afghanistan.

LUNDHEIM, ERLING JACOB (Jun. '45; Assoc. M. '48) Project Engr., Minn. Dept. of Highways, Box 103 Marshall (Res., Marshall), Minn.

LUSK, CHARLES BENTON (Jun. '34; Assoc. M. '48) Senior Engr., Bechtel International Corp., 141 Battery St., San Francisco (Res., 1228 West Selby Lane, Redwood City), Calif.

MCGLASHON, DONALD WALKER (Assoc. M. '44; M. '48) Civ. Engr. (Res., 8905 Eager Rd., Richmond Heights, Mo.)

MCILHENNY, THOMAS HENRY FRANKLIN (Jun. '36; Assoc. M. '48) Engr., The Terrell Bartlett Engrs. (Res., 2320 Main Ave., San Antonio, Tex.)

MOELLER, CLIFFORD MERRILL (Jun. '37; Assoc. M. '48) Asst. Prof., Montana State College, Dept. of Civ. Eng., Bozeman, Mont.

TOTAL MEMBERSHIP AS OF SEPTEMBER 9, 1948

Members	7,196
Associate Members	9,322
Corporate Members	16,518
Honorary Members	40
Juniors	7,474
Affiliates	74
Fellows	1
Total	24,107
(September 9, 1947	22,159)

MORGAN, ELMO RICH (Jun. '35; Assoc. M. '48) Asst. Mgr., U.S. Atomic Energy Comm., Los Alamos (Res., 955 Forty-ninth St.), Los Alamos, N.Mex.

MYERS, WALTER DOW (Jun. '28; Assoc. M. '35; M. '48) Eng. Designer, Pennsylvania Water & Power Co., 1611 Lexington Bldg. (Res., 3215 Milford Ave.), Baltimore, Md.

PALLER, JACK (Jun. '36; Assoc. M. '48) Field Engr. Hydr. Dredging Co. Ltd., 513 Dekum Bldg. (Apt. 3, 9200 North East Prescott St.), Portland, Ore.

PEREZ, HENRY TAYLOR (Jun. '40; Assoc. M. '48) Associate Editor, *Eng. News-Record & Constr. Methods*, 520 North Michigan Ave., Chicago, Ill.

PIERCE, GUY ELLSWORTH (Jun. '43; Assoc. M. '48) Senior Bridge Engr., Sacramento County (Res., 1000 4th Ave.), Sacramento, Calif.

QUINN, RUSSELL CHESTER (Assoc. M. '44; M. '48) Dist. Engr., State Road Comm. of W.Va., Box 310, Keyser (Res., Box 443, Romney), W.Va.

RAYMOND, LAWRENCE ELMER (Assoc. M. '21; M. '48) Chf., Estimating Dept., Bank Bldg. & Equipment Corp. of America, 9th and Sidney Sts. (Res., 3745 Lindell Blvd.), St. Louis, Mo.

RIPPSTEIN, RAYMOND CHARLES (Assoc. M. '46; M. '48) Cons. Engr., Matthews & Kenan, Transit Tower, San Antonio, Tex.

SILBER, VICTOR ARTHUR (Jun. '36; Assoc. M. '48) Field Engr., Horner & Shifrin, Cons. Eng., 803 Shell Bldg. (Res., 4936A Winona Ave.), St. Louis, Mo.

SNELL, JOHN RAYMOND (Jun. '34; Assoc. M. '47) San. Engr., Burns & Kenerson, Inc., 20 Kilby St., Boston (Res., 364 Lebanon St., Melrose), Mass.

STEVENSON, ALBERT HENRY (Jun. '37; Assoc. M. '48) San. Engr., U.S. Public Health Service, 302 Kroger Bldg., Cincinnati, Ohio.

SUMMER, WALTER BASSETT (Jun. '41; Assoc. M. '48) Civ. Engr., Catalytic Constr. Co., 1528 Walnut St., Philadelphia, Pa. (Res., 534 Bridgeboro St., Riverside, N.J.)

SWANSON, WALFRED ERNEST (Jun. '36; Assoc. M. '48) Constr. Engr., Gibbons & Reed Co., 259 West 3rd South (Res., P.O. Box 2452) Salt Lake City, Utah.

TARLTON, ELLIS ALVORD (Jun. '35; Assoc. M. '48) San. Engr., Danbury Water Dept., City Hall (Res., 34 Pleasant St.), Danbury, Conn.

TWINEM, JOSEPH CONRAD (Jun. '30; Assoc. M. '39; M. '48) Metals Economist, War Dept., Price and Distribution Div., Price Branch, ESS, GHQ, SCAP, A.P.O. 500, Care, Postmaster, San Francisco, Calif.

VAN HULSTEYN, JOHN MAX CAREY (Assoc. M. '27; M. '48) Civ. Engr., Board of Water Su[...] (Res., Box 543), Downsville, N.Y.

VARGAS, MILTON (Jun. '45; Assoc. M. '48) C[...] Soils & Foundation Div., Inst. for Technolog[...] Research, Pr. Cel Fernando Prestes 110, [...] Paulo, Brazil.

VOELKER, RAYMOND FRED (Jun. '42; Assoc. [...] '48) Project Engr., Standard Oil Co. of Indi[...] Chicago, Ill. (Res., 1827 North 73rd St., W[...] watosa, Wis.)

WEINROTH, MAX (Assoc. M. '42; M. '48) Se[...] Engr. (Civ.), U.S. Air Force, Deputy Chf. [...] Staff, Materiel, Directorate of Installati[...] Pentagon Bldg., Washington, D.C. (Res., 6[...] Clarendon Rd., Bethesda, Md.)

WIGGINS, BENN ALBERT (Jun. '36; Assoc. M. [...] Structural Designer, Faisant & Kooken, Co[...] Engrs., 2017 Maryland Ave., Baltimore 18, M[...]

WILDER, CARL RUDOLPH (Jun. '30; Assoc. M. [...] (Res., 724 North Homestead Rd., La Gra[...] Park, Ill.)

Reinstatements

ADLER, MILTON ROBERT, Jun., 1869 Dakota, [...] 2, Lincoln, Nebr., reinstated Jan. 1, 1948.

BARTON, HARRY, Assoc. M., Supt. & Engr., Citi[...] Water Supply Co., 163 Cutter Mill Rd., G[...] Neck, N.Y., reinstated Aug. 27, 1948.

COCHRAN, ROBERT LEROY, M., Chf., Civ. W[...] Section, Shoreham Hotel, Washington, D[...] reinstated Aug. 27, 1948.

SWART, REINEIR JOSEPH, Assoc. M., 708 [...] Boulevard, Baton Rouge, La., reinstated Ja[...] 1948.

TAHER, MAHMOOD KHAN, Assoc. M., Asst. C[...] Engr., Atkinson, Drake & Park, Third Septem[...] St., 146, Athens, Greece, reinstated Aug. 20, 1[...]

Resignations

BARRETT, EDGAR LLOYD, Jun., 227 Nesmith [...] Lowell, Mass., resigned Aug. 18, 1948.

BONNELL, RALPH ARNOLD, SR., M., Central Ste[...] Wire Co., Box 5310A, Chicago, Ill., resigned [...] 20, 1948.

DEGNAN, JAMES SCOTT, Jun., 122 Lyndon [...] Edgewood, R. I., resigned Aug. 17, 1948.

DENNIS, WALTER ARTHUR, Jun., 2153 Edgew[...] Blvd., Berkley, Mich., resigned Aug. 30, 194[...]

FREEMAN, ALVIN ZELL, Jun., 18 Bellevue A[...] Providence, R.I., resigned Aug. 19, 1948.

JACKSON, GEORGE ROBERT, Jun., 4730 Ninete[...] North East, Seattle, Wash., resigned Au[...] 1948.

LINDBLOM, LEONARD CARL, Jun., 1106 Orlando [...] Akron, Ohio, resigned Aug. 27, 1948.

LOBEL, IRVING, Jun., 1211 Wheeler Ave., New Yo[...] N.Y., resigned Aug. 27, 1948.

LORNE, JAMES JOSEPH, Assoc. M., 88-07 Bo[...] vard, Rockaway Beach, N.Y., resigned Aug[...] 1948.

MABIN, THOMAS HERBERT, Jun., 12 Rex C[...] Trenton, N.J., resigned Aug. 27, 1948.

MAY, MARVIN CLARK, Jun., Dept. of Civ. E[...] Univ. of New Mexico, Albuquerque, N.M[...] resigned Aug. 27, 1948.

SMITH, CHARLES FRANCIS, Assoc. M., 1615 War[...] Ave., Whiting, Ind., resigned Aug. 27, 1948.

STARKE, DICK DRYDEN, Assoc. M., 1819 South [...] St., Springfield, Ill., resigned Aug. 11, 1948.

STODDARD, ALEXIS ERLING, Assoc. M., 312 [...] Ave., Ames, Iowa, resigned Aug. 27, 1948.

VAN DRIEST, EDWARD REGINALD, Assoc. M., [...] Prof., Mech. Eng., Massachusetts Inst. of T[...] Cambridge, Mass., resigned Aug. 27, 1948.

WALTER, ESTHER BENFORD, Jun., 1623 C. McC[...] St., Charleston 1, W.Va., resigned Aug. 12, 1[...]

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